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Volume XXXVII MAY, 1955 Number 2

THE AGRICULTURAL ECONOMIST IN THE POLITICAL ENVIRONMENT OF POLICY MAKING*

EARL L. BUTZ
U. S. Department of Agriculture

AGRICULTURAL economists perform two separate and rather distinct functions in the process of agricultural policy formulation. The first function is analytical and educational, with a minimum of decision making. The second function is filled with decision making at the policy level, with economic analysis and education playing a subordinate, though still important role.

The analytical economist must remain reasonably "pure." His function is research and education. He is concerned with description, analysis, and projection. He must remain relatively aloof from policy making decisions, else the objectivity of his economic analysis may be influenced one way or the other. His primary function is to apply economic analysis to problems requiring policy decisions, and to set the answers up in terms of alternatives and consequences. Having done this, he then has some responsibility to explain his analysis, still in terms of alternatives and consequences, both with the public and with governmental personnel clothed with the role of policy making decisions.

The second function of the agricultural economist, namely, decision making at the policy level, often is not performed by individuals who are strictly "agricultural economists." These individuals are frequently elected or politically appointed, as contrasted with the "career status" of agricultural economists in the first group.

It is perhaps best that the policy decision making group is not composed primarily of specialized agricultural economists. It is at this level that various social disciplines must be brought to bear on policy formulation. Economics must blend with political science, sociology, philosophy,

* Address by Earl L. Butz, Assistant Secretary, United States Department of Agriculture, Washington, D.C., before the American Farm Economic Association dinner, Detroit, Michigan, December 29, 1954.

and international diplomacy. No single discipline can dominate policy decisions. Since both the objectives and the means of these various disciplines are often at variance, it is small wonder that their blending into a larger and coherent answer is frequently difficult.

The economist seeks to increase efficiency of resource utilization and to maximize returns; the political scientist tends to seek what is expedient, often from a short time point of view; the sociologist seeks answers in terms of human values; the philosopher is concerned with what is thought to be good; and the international diplomat seeks a strengthened security in a peaceful environment.

Only infrequently can these five social disciplines tackle any problem independently and arrive at the same answer. Yet each discipline should tackle each problem fairly independently at the analytical stage, and blend answers only at the policy level. However, it is impossible always to follow this rule rigorously. Objective economic analysis of a problem may give answers completely inconsistent with a realistic political appraisal of the problem. In such cases, should the economic analyst slant his answers to make them more politically acceptable? Indeed not! He may develop two or three alternative answers, with complete analysis of consequences, so that the individual charged with policy decision making may assess each alternative against the backdrop of political analysis, sociological soundness, philosophical attractiveness, and consistency with international goals. But this decision must remain the function of the policy maker—not the analytical economist.

Process of Resolving Economic Questions at the Policy Level

A number of factors influence economic policy determination. In the first place, decisions must be made within the broad framework of the over-all governmental philosophy. This is an intangible entity, which grows out of such things as political platforms, campaign speeches and promises, the personal economic philosophy of the President, his Cabinet members, and leaders in the Congress, the position and strength of the various pressure groups, and finally the general economic temper of the people. Out of this network of influence gradually evolves an over-all philosophy favoring more centralization of governmental power or less, more paternalism or less, more reliance on free price and marketing institutions or less, more decision making in the country or more in Washington.

A second important factor influencing policy determination revolves around the policies and programs of the previous administration. For example, many of the economic decisions affecting agriculture that Secretary Benson has made in the past two years necessarily grew out of the

problems bequeathed him by the outgoing administration when he took over in January 1953. The rigid marketing quotas and tight production controls, for example, which Secretary Benson has been administering the past two years surely are not consistent with his personal philosophy or with the over-all governmental philosophy of the Eisenhower Administration. Yet they were adjudged necessary and administered faithfully, as a means of working gradually toward policies more consistent with the governmental philosophy of the present administration.

A third factor of importance in the determination of agricultural policy is the desire of those who make policy to be primarily economic on the one hand, or primarily political on the other hand. These two attributes are not always opposite, but they frequently are. If the Secretary of Agriculture and his immediate staff are motivated primarily by a desire to make sound economic decisions, then the influence of the agricultural economist will be foremost. If, on the other hand, political considerations dominate the thinking of the Secretary and his immediate staff, then the influence of the agricultural economist will be subordinated. The difference between these two points of view sometimes boils down to the question of whether the Secretary has the courage and the ability "to take it." Sometimes he must be prepared to stand up against intense political pressure, in support of what he considers to be sound economic policy. And sometimes politicians can be wrong too, as they apparently were in the summer and fall of 1954 with respect to the Agricultural Act of 1954.

Compromise is the very essence of democratic government. Our system provides for rule by the majority, with adequate safeguards for the opinions and rights of the minority. There is also frequently compromise within the Administration. Differences between various Departments of the government must be resolved; the White House and one or more Departments of the Executive frequently do not see eye to eye; differences between the Excutive Branch and the Congress must be settled; compromises must be arranged among pressure groups, both within and without agriculture. But out of the whole process of give and take comes governmental decisions which, historically speaking, appear to be pretty good.

If we can assume a desire to make economically sound decisions among our policy making personnel, the ideal procedure appears to be to push economic soundness as far as political expediency will permit. To know this exact point requires a finesse that few people possess. Yet find it we must. And in the meantime, both the professional agricultural economist and the policy decision making economist must pursue a vigorous educational and informational program among the people and the politi-

cians so as to move political expediency and economic soundness ever closer together.

Lloyd George, World War I Prime Minister of Great Britain, once remarked that the first duty of every statesman is to get himself reelected. Otherwise, he can't be a statesman.

It is thus apparent that no governmental leader, however sound, can move very far ahead of the economic understanding and desires of his electorate. Otherwise, his influence will be reduced to zero at the next election. Political expediency is just as simple and just as practical as that.

An Illustration in Policy Formulation

A case history may serve to illustrate the contribution of agricultural economists to policy making in a political environment. Let us review briefly the ground work that led up to the passage of the Agricultural Act of 1954.

Seldom if ever has any Act of Congress been preceded by such widespread and diverse study as was the Agricultural Act of 1954. This study took place in the Agricultural Colleges, among the pressure groups, in the Congress, and in the United States Department of Agriculture.

The three general farm organizations conducted a series of grass root discussions in all parts of the country. These discussions led eventually to the passage of policy resolutions, and a broad educational campaign among their membership based on those resolutions. The resolutions of course were transmitted to the Secretary of Agriculture.

Various non-farm organizations, such as labor unions, chambers of commerce, business and retail organizations, also got into the act. These groups sponsored public forums of one kind or another, and also flooded the Secretary of Agriculture with resolutions both pro and con.

The agricultural committees of the Senate and House of Representatives held a series of hearings in various parts of the country. While some of the testimony presented before these hearings may not have been objective, or even competent when measured by the cold standards of economic analysis, it nevertheless made its impression on the committee members and on the public, and no doubt had considerable influence on the final form of the legislation.

The Department of Agriculture requested the help of Land-Grant Colleges and other groups in the formulation of the legislation to be recommended to the Congress. Many groups of college specialists spent considerable time formulating their own recommendations, which in turn were forwarded to the Secretary. These recommendations were reviewed by the National Agricultural Advisory Committee, which in turn requested further detailed economic analysis of selected specific proposals.

It was at this point that the professional economists in the Department of Agriculture made a valuable contribution.

Working groups were set up in the Department, to do professional economic analysis which would be needed in policy determination. These groups consisted mostly of career economists—program analysists, commodity specialists, and men with administrative experience. In the main, they were civil servants, of unquestioned ability as competent economists. They had been in the Department a long while. They had seen Secretaries of Agriculture come and go, and had witnessed many shifts in agricultural policy. They expected still to be working in Washington when and if the present administration should be replaced. They were in an excellent position to assess the consequences of alternative proposals.

The job at hand was to make effective use of the talents of these career economists within the limits imposed by the ground rules under which new policy would be formulated. The only way a career civil servant can or should be induced to work on problems of this character is to assure him that he will be insulated from reprisals that might result from a change in the political climate.

Such assurance can be given only by centering responsibility for policy decisions within the Secretary's office, among people who, because of the very nature of their jobs, are the most expendable people in government. They change with every administration change.

Within this insulation of security of tenure, the career economists buckled down to work, with a modest amount of guidance from the policy group. They analyzed alternative courses of action and traced probable consequences. The work was done objectively.

At this point the career economists bowed out. They were relieved of responsibility for further decisions. The Advisory Commission chose among the alternatives and made recommendations to the Secretary.

The very act of such widespread public participation in the formulation of the proposed Agricultural Act of 1954 was in itself an invaluable educational medium promoting public understanding of the issues involved. There can be little doubt that the public understanding that grew out of this process made it easier for a vigorous Secretary of Agriculture with the courage of his convictions to "sell" to the people and to the Congress the new philosophy of price support embodied in the Agricultural Act of 1954.

How sound, economically, was the Agricultural Act of 1954, you may ask. The way it finally turned out, was it primarily economic or political?

Such questions can never be answered definitely. Judging from the narrow margin of victory in the Congress, the Act probably was about as sound as the political climate would allow. Some economists, dedicated

to the further strengthening of free prices and free markets, might have argued for a bill in the Congress that would have moved more vigorously away from high level rigid price supports and marketing controls. However, to have done so might have spelled defeat for the entire program.

The policy decision which was made very skillfully walked the tight rope between economic soundness and political expediency. The balancing rod which the Secretary of Agriculture held as he walked that rope was evidently very delicately fashioned. The Act of 1954 represented a reversal of direction in the philosophy of price supports, although the magnitude of change was small—sometimes almost imperceptible.

As the bill neared the closing days of the 83rd Congress, it was necessary again for its proponents occasionally to give and take. Political science then came to the fore. The astute political general knowns when to lose the battle to win the campaign. The professional agricultural economist can make little contribution at this stage.

The Agricultural Economist Has Varied Usefulness in Policy Determination

The contribution of the agricultural economist to legislative formulation is often over emphasized to the exclusion of other important functions. Perhaps his greatest usefulness comes in day to day operations in the Department of Agriculture.

The United States Department of Agriculture is in business up to its ears. The Commodity Credit Corporation is the largest non-financial corporation in America. At the close of 1954 it had more than $7 billion invested in commodities owned or under loan. This figure will probably rise above $8 billion before the winter is over. Total borrowing authority is $10 billion. The Commodity Stabilization Service daily makes business decisions and enters into business transactions involving tremendous quantities of commodities and large sums of money. The Food Distribution Division of the Agricultural Marketing Service is involved daily in business judgments involving large quantities of foodstuffs. The administration of marketing orders frequently calls for policy determination. Decisions must often be made regarding export subsidies, import quotas, expenditure of Section 32 funds for school lunch purposes, surplus removal programs, and the like. Under the Agricultural Trade and Development Act of 1954, which appropriated $1 billion to subsidize export of surplus agricultural commodities over the next three years, important policy decisions are made almost daily by Department personnel.

Operations of this kind call for day to day operating decisions of a business character. They must be tempered by Congressional directives

and by the political realities of the time in which they are made. Decisions of this kind are initiated most frequently by career employees of the Department, usually trained agricultural economists.

Without this hard core of devoted, professional civil servants, undergirding the whole Department of Agriculture, no administration in the Secretary's office can successfully make the policy determinations now vested in the Department of Agriculture.

We Need Both the "Pure" Economists and "Policy Making" Economists

The Department of Agriculture is fortunate in having many devoted and competent career economists. These men are well schooled in the techniques of scientific research, and justly take pride in their objectivity. These qualities must be preserved at all cost. These men have served equally well under Secretary Benson, Secretary Brannan, and a number of secretaries before them. They have kept themselves aloof from policy determination. The scientific objectivity of their analysis is therefore accepted by any administration which happens to be in power. What the administration decides to do with their analysis is quite another thing.

It may be that some day the professional agricultural economist can argue either side of an economic question with professional immunity, just as the lawyer can today. The ethics of the legal profession permit this. The lawyer takes a case, and admittedly presents only one side of the evidence. But in his case he has an impartial judge to decide the issue. The economist has no judge, other than the public.

We look with some disfavor on the professional economist who, either wittingly or unwittingly, represents only one side of the question. It is my sincere hope that the professional agricultural economist will always remain duty bound to explore objectively all sides of the question, and to present a complete and impartial analysis, whether it be good or bad, to the individual who is ultimately charged with policy decision making.

The Professional Economist Is More Essential Now Than Ever Before

Never before in our history was the need greater for competent and objective agricultural economists. The level of economic literacy of our people must be raised, if sound economic philosophy on a continuing basis is to find expression in our legislative halls.

The role of government in business and agriculture has increased tremendously in the last two decades. This trend may slow down temporarily, but it will not be reversed. We live in the age of the "welfare state." Whether we like it or not is beside the point. If I were to use a single word to characterize the 20th Century, I think it would be "security." All about us we see a universal quest for security. We see it among

individuals, among business organizations, among farm and labor organizations, among states, and among nations. We have seen rise in our generation the new philosophy of a permanent direct subsidy for agricultural producers. We have seen the development of a still newer philosophy of a permanent subsidy for consumers in the form of cheap foods.

This means that it is now doubly important for all of our people to have a pretty basic understanding of the function of government in our kind of economy. It is important that they understand such things as supply, demand, and price relationships.

If we believe there is merit in relatively free economic institutions in our society, it is important that the electorate understand the advantages and disadvantages of such a system.

If we believe that governmental policies should be pursued that place some restraint on endless attempts to reach into the United States Treasury for assistance to this group or that, then it is important that millions of people understand more fully the relationship between their government and their own personal well-being.

Economics is a very difficult science. It deals with human beings, with all their prejudices, ignorances, and half-truths. It deals with the relationship of men with men, of men with government, and of government with government. The area of its application changes so rapidly that answers good today may not apply tomorrow. Yet those of us who are charged with research and education in this important area must never shirk before the task ahead of us.

Sound governmental decisions in the economic area can never go very far ahead of the level of economic literacy of the people.

The importance of good economic education at the grass roots of America can never be overestimated. This will influence present legislation, as well as the economic thinking of our leaders a generation hence.

Who among us can deny that perhaps one of the most influential men in the formulation of agricultural policy in 1954 was some obscure teacher of economics a generation ago who planted in the youthful mind of Ezra Taft Benson a firm understanding of the economics of supply, demand, and price? Who among us can deny that some sincere schoolmaster who taught Ezra Taft Benson the value of free institutions and personal integrity exerted a tremendous influence on agricultural policy in 1954?

The challenge of imaginative leadership in research and education which today lies before our agricultural economists is unparalleled in our history.

Thus, the agricultural economist who regards himself as "purest"—untainted by the political environment of governmental policy determination—may, in the final analysis, be the most influential of all in public policy determination.

SURVEYS OF ECONOMETRIC RESULTS IN AGRICULTURE*

Chairman: Joseph Ackerman, Farm Foundation

DEMAND AND PRICES

RICHARD J. FOOTE
Agricultural Marketing Service

SEVERAL excellent summaries in this area have been published within the past year. In a paper presented in the summer of 1953 before the American Farm Economic Association, George Kuznets[1] discussed the major statistical and quasi-statistical questions that face research workers in this field and presented results from a number of studies dealing with elasticities of demand for total food, food livestock products, total meat, and beef, pork, and eggs. He included only studies for which results had been obtained by a variety of basic methods and concluded that, with certain minor exceptions, each of the methods gave nearly the same results in terms of coefficients obtained and each appeared to be equally unreliable in making forecasts for the immediate post-World War II years.

Karl Fox[2] in 1953 presented results covering each major farm product or group of products for which he felt that unbiased estimates of coefficients of elasticity could be obtained by the single-equation approach. In addition to the products covered by Kuznets, he gave coefficients of elasticity for poultry meat, feed grains, and a number of fruits and vegetables. Although his analyses were based on data for the 1922-41 period, as were most of those discussed by Kuznets, he concluded that "most of the prewar regression equations stood up well when tested against actual experience in 1947-52." In some cases, however, he made adjustments to allow for the "social factors" which Kuznets considered as important elements in causing forecasting errors for these years.

Richard Stone[3] in 1954 published elasticities for a large number of consumer goods in Great Britain and Herman Wold and Lars Jureen[4] in 1953 issued a similar study based on Swedish data. A weakness of

* Proceedings of a joint meeting of the American Farm Economic Association and the Econometric Society in Detroit, December 29, 1954.

[1] G. M. Kuznets, "Measurement of Market Demand With Particular Reference to Consumer Demand for Food". *This Journal*, 35:878-895, December 1953.

[2] Karl A. Fox, "The Analysis of Demand for Farm Products". U.S. Dept. Agr. Tech. Bul. 1081, September 1953.

[3] Richard Stone, *The Measurement of Consumers' Expenditures and Behavior in the United Kingdom, 1920-1938*. Cambridge Univ. Press, 1954.

[4] Herman Wold and Lars Jureen, *Demand Analysis: A Study in Econometrics*. John Wiley, 1953.

many of these analyses is that a relatively uniform method was applied in all cases, regardless of whether it was directly applicable.

As my time is limited, I propose to cover areas that were not included in the summaries mentioned above and, in a sense, to bring them up to date. Readers who desire a complete coverage thus will need to consult the references cited above. I will first consider 4 fields in which I feel that significant advances are being made and then will discuss briefly the research work being done under my supervision in the Agricultural Marketing Service.

Further Experiments with the Simultaneous-equations Approach

Many studies cited by Kuznets were run by a simultaneous-equations technique. For most of these commodities Fox has given convincing evidence that elasticities of demand can be determined without significant bias by the single-equation approach. Hence we might expect that results from single- or simultaneous-equation methods would be nearly the same. For other commodities, however, simultaneous equations are clearly needed to adequately represent the basic economic structure. For these commodities we can expect significantly better results by use of the relatively new simultaneous-equation approach.

Results of attempts to measure the elasticity of demand for dairy products by use of the single-equation approach have been notoriously poor. In his 1953 bulletin Fox said: "It is doubtful whether a satisfactory statistical model of the dairy industry could be derived by any means now known. Any detailed analysis of the demand-supply structure for dairy products must be conceived in terms of many simultaneous equations." About a year after this was written, Anthony Rojko[5] published elasticities with respect to price for dairy products based on some 3-equation just identified models that at least show promising results. Rojko indicates, "Price elasticities estimated from single equation models were found to be substantially lower than the estimates from the 3-equation model." Further research by Rojko in this area will be discussed in a technical bulletin which we hope to finish during the current fiscal year.

Wheat is another agricultural product for which simultaneous equations appear to be needed if elasticities that apply to separate outlets are to be measured. Despite the importance of this commodity, no recent demand studies have been published. Kenneth Meinken of our staff has fitted a 6-equation model for wheat that involves an equation relating to the "world" (Liverpool) price, equations relating to domestic use for food, feed, export, and end-of-season storage, and an identity that states that

[5] Anthony S. Rojko, "An Application of the Use of Economic Models to the Dairy Industry". *This Journal*, 35:834-849, December 1953.

the sum of the uses must equal the total supply. The limited-information approach, based on pre-World War II data, was used. The coefficients were not greatly different from those obtained when the same equations were fitted by least-squares, but the simultaneous-equations model has distinct advantages as an expository and forecasting device. In fact, single equations cannot be used for forecasting because domestic prices and use for at least feed, storage, and export must be predicted simultaneously. The model was applied under post-war conditions with and without an effective price-support program. Results, particularly for 1952 and 1953, were surprisingly good.

Larry Boger and William Cromarty of Michigan State College are fitting a somewhat similar model for apples, except that they are using data by quarters instead of that relating to an entire marketing year. The model is described in a publication issued in 1953.[6] Results have been obtained for 2 quarters. The analysis is based on data for the years 1929-51 and the equations are being fitted by the limited-information method. Results have been generally satisfactory, whereas a number of "wrong" signs were obtained when similar equations were fitted by the method of least-squares. This study is significant in that meaningful estimates of the parameters were gained using aggregate data in the short run. Data for several other farm products probably can be analyzed in a similar fashion.

Although lumber is not an agricultural product, it is perhaps closely enough related to be included in this survey. Irving Holland of the Forest Service in an unpublished study[7] has fitted a 2-equation model relating to the demand and supply for construction lumber. Price appears to have a significant effect on shipments from the supply side but not from the demand side. Hence the equations were refitted using the recursive approach. This method is of interest particularly because it was recommended by Wold and Jureen as a substitute for the simultaneous-equations approach. Only the coefficients for the supply equation are directly comparable. Klein[8] indicates that the recursive approach will yield estimates of the coefficients that are statistically "consistent" (or unbiased when based on extremely large samples) in situations of this sort, but that the standard errors relative to the coefficients may be larger than if the coefficients were estimated by a simultaneous-equations approach. For this equation, relative standard errors were about one-third as large

[6] "An Experiment in Designing an Econometric Model to Explain Short Term Demand Fluctuations for Apples". Excerpts from a M.S. Thesis by W. A. Cromarty, 1953, under supervision of L. L. Boger, Department of Agricultural Economics, Michigan State College. (Processed.)

[7] Irving I. Holland, "Some Factors Affecting Consumption of Lumber, With Emphasis on Demand." September 1954.

[8] Lawrence R. Klein, *A Textbook of Econometrics*, Row-Peterson, 1953, pp. 90-92.

for the simultaneous-equations method as for the recursive method.

Two more studies in the simultaneous-equations area should be mentioned. A study by Glenn Johnson[9] on burley tobacco, published in 1952, was not included in the Kuznet's summary in part at least because no comparable study had been made by the single-equation approach. In this study the endogenous variables were the season average price received by farmers at auctions and pledges of tobacco under the price-support program. This example is of particular interest because it was used to analyze the effect of a support program. Our 6-equation model for wheat can be used in a similar way. The second is an analysis of the supply-demand structure for watermelons presented by Daniel Suits at another session of the December 1954 meetings.[10] He computes a crop supply schedule based on least-squares, a market supply schedule that allows for partial harvesting due to economic reasons, and a demand schedule. His paper includes an interesting discussion of modifications in the cobweb theorem that are required when use is made of a separate market-supply equation.

One problem when working with simultaneously-determined variables is that the estimates of the coefficients and their standard errors are unbiased only when based on extremely large samples. Mathematical problems in obtaining methods that apply to small samples have proved insurmountable. An approach being considered and now underway on a small scale is the drawing of samples and analysis of the resulting data for a large number of small samples by a programmed approach using large-scale computors. This general approach may well provide answers to many of the questions that now face research workers. Such questions include the effects of serial correlation in the residuals or of errors in the data as well as those relating to the necessity of working with small samples.

Introduction of Dynamic Elements into Least-square Analyses

For many years lagged values of economic variables have been used in equations relating to demand in order to introduce dynamic elements into the analysis. As this method is well known, references to cases in which it has been used will not be discussed here. Several novel approaches in this area have been made within the past few years, however, and those that have come to the author's attention will be mentioned.

The most detailed study of which I know is that by Jerry Foytik[11] for

[9] Glenn L. Johnson, "Burley Tobacco Control Programs: Their Over-all Effect on Production and Prices, 1933-50." Ky. Agr. Expt. Sta. Bul. 580, 1952.

[10] Daniel B. Suits, "An Econometric Model of the Watermelon Market." *This Journal*, current issue.

[11] Jerry Foytik, "Characteristics of Demand for California Plums." *Hilgardia*, 20:407-527, April 1951.

California plums, published in 1951. In his final equation, which deals with factors that affect price in a specific week, he uses as independent variables quantities in the current and preceding week, week of season, and consumer income, and allows for systematic changes in the regression coefficient on income as the season progresses. Major conclusion that relate to this phase of the study are as follows:

1. "Temporal markets are definitely interrelated—that is, current prices are affected by sales made earlier in the season as well as by sales made currently."
2. "The net price-income relation becomes materially less steep as the season advances."
3. "Price is more responsive to changes in sales during the peak of the season than earlier or later—thus demand is less elastic during mid-season than for either earlier or later sales."

Frank Lowenstein and Martin Simon[12] use a very different approach to introduce dynamic elements into a study of factors that affect mill consumption of cotton. They allow for imbalances in mill inventories of cotton cloth by including as a variable the ratio of stocks to unfilled orders expressed in terms of deviations from a "normal" ratio. When the ratio is relatively high a downward adjustment in output to reduce stocks is indicated. Conversely a relatively low ratio suggests the likelihood of a higher output rate in the near future. They found that this variable, along with current and lagged consumer income, consumption of synthetic fibers, and deflated prices of cotton, explained 95 percent of the variation in cotton consumption during the years 1927-32, 1935-40, and 1948-52. These were the only years for which the stock-order ratio was available. All of the regression coefficients differed significantly from zero. An analysis for the same years but for which the stock-order ratio was omitted explained only 84 percent of the variation in cotton consumption.

Ben Pubols[13] has recently published an article that is of interest because he uses successive estimates of the size of crop in forecasting prices. Grower prices for apples in September, October, and November, in turn, were correlated with August estimates of production and fourth-quarter disposable income. Similarly, prices in November, December, and January were correlated with October estimates of production and the same income variable. These analyses suggest that prices in September are only moderately influenced by the size of the fall crop and that by January, as would be expected, the effect of the October estimate on prices is reduced as it is replaced as a market influence by the December estimate.

[12] Frank Lowenstein and Martin S. Simon, "Analyses of Factors That Affect Mill Consumption of Cotton in the United States." *Agr. Econ. Research*, 6:101-110, October 1954.

[13] Ben H. Pubols, "Factors Affecting Prices of Apples." *Agr. Econ. Research*, 6:77-83, July 1954.

Results for November are nearly as good based on the August production estimate as on the October estimate. Similar analyses were run for the spring months using successive monthly stocks and income as independent variables. The percentage of variation in price explained by these factors is highest in March and then declines through May, the last month included in the study.

Analyses Based on Data from Consumer Panels or Sales from Retail Stores

Standard time series analyses that make use of conventional sources of data are not feasible in a number of areas either because of a lack of data or because of their basic complexity. Three principal types of studies for which this is true are those dealing with competition between a large number of separate products, those attempting to analyze demand for separate grades or qualities of a product, and those dealing with the demand for newly introduced commodities. A number of studies are underway in these areas that make use of data from consumer panels or daily or weekly sales from retail stores.

Published results so far consist chiefly of a discussion of the problems involved in the use of such data and some preliminary findings. Brief summaries of 3 papers presented at the December 1953 meetings of the combined social science societies were published in 1954.[14] Charles Zwick of Harvard University presented a paper at the September 1954 meeting of the Econometric Society dealing with results from a study on meat, fish, and poultry, using consumer panel data. And at the August 1954 meeting of the American Farm Economic Association I gave a brief discussion of a study dealing with competition among deciduous fruits and effect of quality on sales based on daily sales in a group of supermarkets in Denver.[15] This study is being made by the Technical Committee of the Western Regional Deciduous Fruit Project. George Kuznets has done a great deal of work on competition among citrus products, with emphasis on frozen orange juice, using monthly consumer panel data. Results of this study, which was conducted by the University of California in cooperation with the Agricultural Marketing Service, should be published within the next 6 months or so. Further details on the Denver study and the studies on citrus are included in a handbook dealing with analysis of demand that Fox and I issued early in 1954.[16]

[14] *Jour. Amer. Statis. Assoc.*, 49:361-362, June 1954. The papers were "The Demand for Citrus Products" by George M. Kuznets and Richard J. Foote; "An Analysis of the Demand for Meat" by Ayers Brinser, Harry Allison, and Charles Zwick; and "Demand Analysis from the M.S.C. Consumer Panel" by G. G. Quackenbush.

[15] Richard J. Foote, "Discussion." *This Journal*, 36:858-860, December 1954.

[16] Richard J. Foote and Karl A. Fox, "Analytical Tools for Measuring Demand."

Zwick found significantly different price elasticities of demand for beef in groups classified by age of housewife, after allowing for variation in family income. Demand was relatively elastic for young housewives and highly inelastic for older housewives. This finding could not have been obtained from the analysis of either budget data or an aggregative time series.

By far the most complete analysis that I have seen in this area is an unpublished study by Harold Riley dealing with the demand for meat based on weekly data from the Michigan State College consumer panel for the period July 1951-June 1953.[17] Fortunately this was a period of substantial price changes for both beef and pork. Riley expressed the quantity purchased of one kind of meat as a function of the price of that meat group, prices of competing meats, and a temperature variable that was found to have significant effects on demand in summer.

Elasticities and cross-elasticities of demand for *kinds* of meat, such as beef and pork, were similar to those derived by other research analysts from time series data. The major contribution of Riley was the measurement of elasticities for retail *cuts* of meat. The price elasticity of demand for beef steak was highly elastic; for beef roasts, ham, and pork chops, were slightly elastic; and for ground beef and bacon, were slightly inelastic. Further studies along these lines for meats and a number of other commodity groups have been completed or are currently underway at Michigan State College.

Use of Spatial-Equilibrium Analyses to Study Export Demand

Karl Fox in 1953 applied spatial-equilibrium analysis to the livestock-feed economy.[18] In 1954 he showed how this approach might be used in studying the effect on the pattern and volume of trade among several countries or groups of countries of changes in tariffs and export subsidies, or of the introduction of a two-price plan.[19]

If exports for a given country are determined chiefly by the spread between the price in major importing countries and the domestic price, as for wheat, then a system of simultaneous equations similar to that described previously can be used to measure the elasticity of demand for exports. This elasticity chiefly reflects the fact that when exports are large

U.S. Dept. Agr. Agr. Handbook 64, January 1954, pp. 68-74. The method of analysis for the data from stores outlined in this handbook has been modified as indicated in my paper referred to in footnote 15.

[17] Harold M. Riley, "Some Measurements of Consumer Demand for Meat." Ph.D. Thesis, Michigan State College, 1954.

[18] Karl A. Fox, "A Spatial Equilibrium Model of the Livestock-feed Economy in the United States." *Econometrica*, 21:547-566, October, 1953.

[19] Karl A. Fox, "The Use of Economic Models in Appraising International Trade Policies." *This Journal*, 36:944-958, December, 1954.

the commodity must be transported over longer internal distances and the price spread must be sufficient to cover the added transportation costs. For other commodities, such as cotton, tobacco, and some fruits, exports come from essentially the same internal geographic areas regardless of whether they are relatively large or small. In such circumstances, a spatial-equilibrium analysis for individual years might more nearly indicate the economic forces that affect the quantities exported from a given country. In such a study, it is presumed that each importing country imports from the cheapest available source, that consumption in both exporting and importing countries depends in part on the prevailing price, and that prices are at a level such that supply equals demand in the economic sense and aggregate world transportation costs are as low as possible. Effects of bilateral agreements, tariffs, subsidies, and other institutional forces can be built into the analysis. This appears to be a promising avenue for resarch, and we plan to initiate studies along these lines for certain export crops.

Undoubtedly there are other areas in the demand and prices field in which new developments with respect to the application of econometrics to agriculture are taking place, but these are the ones with which I am most familiar.

Demand and Price Structure Research in AMS

We have a research project, initiated in 1947 under the Agricultural Marketing Act of 1946, in which we plan to study the supply, demand, and price structure for each major agricultural product or group of products. These studies are fairly uniform in the sense that in each we develop descriptions and diagrams of principal economic forces that affect the commodity, together with appropriate background information, and identify and measure statistically the influence of major factors. The detailed approach differs materially from commodity to commodity, however, depending on the nature of its economic structure. The regression analyses frequently apply to season average prices for the entire country, but discussions are included of price differentials or patterns by months and between grades and geographic areas.

The results generally are published in technical bulletins in our "Demand and Price Structure" series. So far we have published bulletins of this sort dealing with wool,[20] feed grains,[21] food fats and oils,[22] vege-

[20] Albert M. Hermie, "Prices of Apparel Wool." U.S. Dept. Agr. Tech. Bul. 1041, 1951.

[21] Richard J. Foote, John W. Klein, and Malcolm Clough, "The Demand and Price Structure for Corn and Total Feed Concentrates," U.S. Dept. Agr. Tech. Bul. 1061, 1952; Richard J. Foote, "Statistical Analyses Relating to the Feed-livestock Economy," U.S. Dept. Agr. Tech. Bul. 1070, 1953; Kenneth W. Meinken, "The Demand and

tables,[23] and peanuts.[24] We hope to complete within the current fiscal year bulletins on wheat and dairy products; and we have additional projects underway that relate to cotton and other fibers, tobacco, high protein feeds, cattle, all meats, poultry and eggs, and milk. Preliminary results from some of these have been referred to previously. Additional projects will be started as funds permit. In addition, we have published or have in progress certain statistical bulletins that furnish required background material,[25] several agricultural handbooks that discuss research procedures,[26] and numerous journal articles and other publications that relate to procedures or findings.

This work is designed to give a sounder basis for the price, production, and consumption forecasts made by commodity specialists in the Agricultural Marketing Service and by extension staffs at state colleges; to aid government administrators and others (1) in evaluating the probable effects of various types of price support programs, (2) in determining the probable incidence of changes in tariffs, freight rates, processing taxes, and export and import subsidies, and (3) in measuring probable effects on total farm income of programs that tend to change total production; and to furnish background information and analyses to extension workers and research staffs at colleges, trade associations, and processing industries who may be involved in economic research relating to the particular commodity.

Many colleges and other research institutions have similar projects that relate to specific commodity fields or deal with aspects that cut across commodity lines but, so far as I know, this is the only project in the price and demand area that plans to systematically cover each major agricultural commodity group.

Price Structure for Oats, Barley, and Sorghum Grains," U.S. Dept. Agr. Tech. Bul. 1080, 1953.

[22] Sidney J. Armore, "The Demand and Price Structure for Food Fats and Oils." U.S. Dept. Agr. Tech. Bul. 1068, 1953.

[23] D. Milton Shuffett, "The Demand and Price Structure for Selected Vegetables." U.S. Dept. Agr. Tech. Bul. 1105, 1954.

[24] Antoine Banna, Sidney J. Armore, and Richard J. Foote, "Peanuts and Their Uses for Food." U.S. Dept. Agr. Marketing Research Rept. 16, 1952.

[25] "Statistics on Cotton and Related Data," U.S. Dept. Agr. Statis. Bul. 99, 1951, and Antoine Banna, "Oilseeds, Fats and Oils, and their Products, 1909-53," U.S. Dept. Agr. Statis. Bul. 147, 1954.

[26] Foote and Fox, *Op. Cit.*, and R. J. Foote and Karl A. Fox, "Seasonal Variation: Methods of Measurement and Tests of Significance," U.S. Dept. Agr. Agr. Handbook 48, 1952. We have in process 2 more handbooks that we hope to complete within the current fiscal year, one on graphic analysis in economic research and one on computational procedures when working with systems of simultaneous equations.

RESULTS FROM PRODUCTION ECONOMIC ANALYSIS

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THIS summary of econometric results from agricultural production economics analysis will be confined primarily to farm management and agricultural policy. In general, econometric results will be defined broadly to include results of applying economic theory, statistics and mathematics to the solution of problems. In addition to summarizing results, problems will be pointed out that require more formal econometric training for their solution than is possessed by most agricultural economists. This emphasis will suggest contributions that econometricians can make to the work of production economists.

As there has been some controversy about the relative productivity of "traditional" farm management workers and production economists working in the field of farm management, the summary is organized under four somewhat historical headings in the hope of gaining some historical perspective: (1) agricultural economists receive their heritage, (2) the unendowed, (3) the heirs and the unendowed unite and, finally (4) dynamics—a weakness of both heirs and the unendowed. The heirs, in this case, are the agricultural economists who received and used classical and neoclassical theory. The unendowed are those who have worked without benefit of that theory.

Agricultural Economists Receive Their Heritage

In a sense, agricultural production economics is one of the oldest subfields in economics. The classicists were fundamentally concerned with productivity—in large part, agricultural productivity—and with policies for increasing productive efficiency. As marginal analysis reached a climax with Alfred Marshall, agricultural economics was just beginning to emerge as a discipline in the land-grant colleges.[1] Members of the new discipline were among the rightful and fortunate heirs of the wealth of theoretical thought accumulated by the classicists and neo-classicists.

H. C. Taylor called the attention of agriculturalists to their heritage.[2] In the field of farm management, W. J. Spillman and John D. Black took the leadership in applying economic principles to farm enterprise and business problems. Agricultural production economics grew up

* The author is indebted to Larry Witt, Dale Hathaway, Warren Vincent and Dale Butz for helpful criticisms and suggestions.

[1] T. W. Schultz, "Scope and Method in Agricultural Economics Research," *Journal of Political Economy*, Vol. XLVII, 1939, p. 709.

[2] H. C. Taylor, *The Story of Agricultural Economics* (Iowa State College Press, Ames, Iowa), 1952, pp. 101-104, 125-129.

largely as a result of Black's attempts to quantify production economic concepts as a basis for profit-maximizing recommendations to farmers. Eventually, a Bankhead-Jones appropriation was secured to carry out experimental work designed to yield estimates of production functions. Major series of coordinated experiments were sponsored by the U. S. Department of Agriculture in cooperation with several different state experiment stations. These experiments, which had to do with milk, pork and beef production, yielded some of the best production function data yet available.[3]

The dairy data proved particularly useful. In addition to being the basis for a vast number of technical and semi-popular experiment station bulletins, theses and reports, they have been used to construct feeding tables showing how to adjust feeding rates to changes in milk, grain and hay prices.[4] At the Michigan station, one of our most widely used bulletins[5] and two theses, both of which are leading to current bulletins, are based on these data.[6] One of the new bulletins will contain an estimate of the supply curve for milk in the Detroit milk shed while the other accompanies a slide-rule gimmick for figuring out how much can be paid for dairy cows of different quality under different price conditions.[7]

Until very recently, the data produced in the pork production experiments were the best pork production data, from an economic point of view, in existence. These data, too, have been widely used and have been carried directly to pork producers in semi-popular studies showing how the most profitable marketing weight for hogs varies with weight discounts and the prices of corn and hogs.[8]

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[3] See E. Jensen, et al., *Input-Output Relationships in Milk Production*, U.S. Department of Agriculture Technical Bulletin 815, 1942; L. Jay Atkinson and John W. Klein, *Feed Consumption and the Marketing Weight of Hogs*, U. S. Department of Agriculture Technical Bulletin 894, 1945; and A. G. Nelson, *Relation of Feed Consumed to Food Products Produced in Fattening Cattle*, U. S. Department of Agriculture Technical Bulletin 900, 1945.

[4] "More Grain for Your Dairy Cows," *The Agricultural Situation*, U. S. Department of Agriculture, Vol. 33, February, 1949.

[5] C. R. Hoglund and K. T. Wright, *Reducing Dairy Costs on Michigan Farms*, Agricultural Experiment Station, Michigan Agricultural College and U. S. Department of Agriculture cooperating, Special Bulletin 376, May, 1952.

[6] G. E. Shuh, *A Short-run Supply Curve Estimate for Fluid Milk, Detroit Milk Shed, October, 1951-September, 1952*, unpublished M.S. Thesis, Department of Agricultural Economics, Michigan State College, 1954; D. A. Caul, *A Technique for Evaluating the Productive Worth of a Dairy Cow*, unpublished M.S. Thesis, Department of Agricultural Economics, Michigan State College, 1954.

[7] D. A. Caul, "Cow-valuator," a forthcoming publication of the Cooperative Extension Service, Michigan State College, 1955.

[8] "How Heavy Should I Feed My Hogs," *The Agricultural Situation*, U. S. Department of Agriculture, Vol. 33, January, 1949; and Harold Riley, *What is the Most Profitable Weight to Market Hogs*, Michigan State College Cooperative Extension Service, Ext. Bulletin 321, 1953.

While the empirical data gathered in the beef experiments were good, they have never been as widely used as the data produced by the pork and dairy experiments. There appear to be two reasons for this which should be looked at briefly. *First*, the proportion of roughage used in producing beef is easily varied over a wide range and there are serious problems involved in pricing pasture, silage and hay. These inputs are generally farm produced and often poorly priced. Once the growing season is over, transportation and handling costs often make the net cost of acquiring them twice the net return realizable in selling them. Between these two prices such inputs are worth their marginal value productivity. If marginal value productivity is less than acquisition cost and more than salvage value, it does not pay to either sell part of the roughage off the farm or to buy additional roughage to add to that grown on the farm.[9] Marginal value productivity is, in turn, tied up with dynamic managerial processes and changes in the quality of beef produced by roughage vs. grain which leads us to the *second* difficulty. Beef fattening is as much a question of producing quality as of producing pounds of beef. Marketing data on what packers and consumers are willing to pay for quality in beef production have remained too fragmentary and inadequate to apply economizing principles in locating least cost combinations for roughage and grain and high profit points. Beef production and the utilization of roughage vs. grain are problems of the first order in the American agricultural economy. Beef provides one way of utilizing the roughage produced by soil conserving farming. It also provides a way of utilizing the grasses which can be produced in the mid-South. Before production economists can complete their work in this area, we need to know more about the theory of fixed assets, the demand of consumers for beef quality and the role of management in determining the marginal value productivity of forage inputs in beef production. Econometricians can help on all three of these difficulties.

The Unendowed

Before summarizing more of the studies applying production economics theory in agriculture, we need to consider a group of productive men who, for the most part, were not in position to inherit the economic thought of the classicists and neo-classicists. Even though no departments of farm management existed in the early years of the land-grant colleges, it soon became evident that work on individual enterprises had to be integrated. Thus, farm management courses were developed and taught by men who were not economists, either by training or, in many cases,

[9] Glenn L. Johnson and L. S. Hardin, *Economics of Forage Evaluation*, N. C. Regional Publication, 1955 (in process, Purdue Agricultural Experiment Station).

by choice. As these men considered themselves farm managers, not economists, they developed their science along an empirical route without claiming their share of the heritage of economic thought.[10]

An important contribution of the group has been its favorable influence on members of the more theoretical agricultural production economics group. This favorable influence has been of a three-fold nature; *first,* it has helped concentrate the work of production economists on "real" problems; *second,* it has stimulated production economists to review and revise theoretical concepts by exposing, at times, discrepancies between reality and empirical solutions built on unrealistic theory and, at other times, demonstrating with its empirical naivity the need for conceptualization, and *third,* its use of budgeting, a less formal equivalent of linear programming, served to prepare agricultural economists to use and interpret the results of linear programming.

The Heirs and Unendowed Unite

There was some friction as the descendents of the empirical line of farm management men came into contact with the more econometric farm management work developed by Black and Spillman.[11] Vested interests and loyalties had developed in both groups and disciples were more dogmatic than originators. One group was empirical. The heirs, on the other hand, tended to be experimentalist or econometric in the sense that its members looked to theory as well as data for guidance in defining and solving problems. The empiricists regarded themselves as closer to reality and hence more practical and realistic than the users of theory. The other group in turn considered its members as trained deductively as well as inductively. The empiricists sometimes regarded theory as a source of dangerous preconceptions. Those using theory regarded empiricism, without systematic use of theory, as a source of spurious unmeaningful conclusions. Probably neither group granted the possibility that members of the other might possess its own prided virtues.

These two groups of farm management workers began to interact as Black's work spread to other colleges and experiment stations. As the empirical work has been wide spread, it could not extend its domain significantly. At Iowa State College, Atkinson's work on pork production and Boulding's teaching helped Earl Heady develop a basic interest in this

[10] T. W. Schultz, "Scope and Method in Agricultural Economics Research," *Journal of Political Economy,* Vol. XLVI, 1939, p. 707f; and Taylor, *op. cit.* pp. 80-98. In this discussion, Taylor overemphasized the speed with which the cleavage between the heirs and the unendowed was healed. See especially the bottom of p. 97.

[11] Two workshops in farm management, one at Land O'Lakes, Wisconsin in 1949 and another at Black Duck, Minnesota in 1949 and both sponsored by The Farm Foundation operating through the North Central States Farm Management Research Committee, brought the conflict to a head and laid the groundwork for the union.

area. During the war and post war years, he greatly elaborated and expanded this interest. His contributions to the field of agricultural production economics are presented in his land-mark work entitled *Economics of Agricultural Production and Resource Use.*[12] In the post-war years the production economics point of view was spread via the North Central Farm Management Research Committee until most states in the North Central region, including Kentucky, now have fairly well developed programs of production economics research as well as earlier more empirical farm management research programs. The same is increasingly true of Southern and Western States.

Although an undue portion of the production economics work being done in the various states is still based on the three fundamental sets of production data produced under Black's leadership, several more recently inaugurated studies should be given special attention. One of these includes the experiments run by Catron, Heady, et al. on pork production,[13] which explored the marginal rate of substitution between carbohydrates and protein with and without the use of modern antibiotics, thus extending considerably the knowledge of pork production functions obtained earlier under Bankhead-Jones appropriations. Mention should also be made of the fertilization experiments undertaken at Iowa by Heady and Pesek.[14] These studies have yielded an estimate of the production function for nitrogen and phosphate fertilizers in the production of corn. The same experiments will yield further results for other crops. Mention should also be made of the input-output work in poultry production at Washington and Connecticut.

Two popularized methods have been developed for presenting the results of these experiments. One of these is the "Pork Costulator" developed at Ames for computing least-cost, protein-carbohydrate rations for hogs as well as making a choice between different marketing weights.[15] Another, developed at Connecticut, is used in estimating the most profitable weight, feed requirements, age and net returns above feed costs in broiler production.[16] The "Pork Costulator" is sponsored by

[12] Earl Heady, *Economics of Agricultural Production and Resource Use*, Prentice-Hall, New York, 1952.

[13] E. Heady, R. Woodworth, D. Catron and G. Ashton, "Productivity Coefficients in Pork Output," *This Journal*, Vol. 35, 1953, pp. 341-354.

[14] Earl O. Heady and John Pesek, "A Fertilizer Production Surface with Specification of Economic Optima for Corn Grown on Calcareous Ida Silt Loam," *This Journal*, Vol. 36, 1954, p. 466f.

[15] D. V. Catron, E. O. Heady and G. C. Ashton, *Pork Costulator for Calculating the Most Profitable Ration*, Iowa State College (Vernon Company, Newton, Iowa) 1954.

[16] I. F. Fellows, George C. Judge and T. C. Morrison, *Broiler Marketing Guide*, Connecticut Agricultural Extension Service and Storrs Agricultural Experiment Station, MP-41, May, 1954.

Better Farming, a popular farm magazine, which sells it for two dollars. The other is distributed at public expense by the Connecticut Experiment Station.

In connection with both of these gimmicks, certain "length-of-run problems" arise. For instance, the broiler gimmick shows the most profitable weight at which to sell a given flock of birds on the assumption that they will not be replaced. In practice, operators often produce broilers on a continuous basis with birds as well as feed handled as variable inputs. Under these conditions the "least cost combinations" of birds, feed and labor, involve much lighter weights. When hogs are fed on a continuous basis rather than on litter systems, similar questions arise with respect to the Pork Costulator.

Several input-output experiments have been run in the South at North Carolina and Kentucky on corn and pasture fertilization with some data being produced in both instances. Currently, other studies are underway or getting underway at Ontario Agricultural College, Michigan State College, the University of Kentucky and at several other points. At Purdue, Kehrberg, is attempting to fit production functions to yield and soil test data recorded in the soil testing laboratories. These studies will produce data from which production functions for different fertilizers and crops can be estimated. In connection with fitting production functions to input-output data, four serious problems exist: (1) not enough is known about the different mathematical functions that may be useful in fitting production functions, (2) not enough is known about appropriate experimental designs for producing data to use in fitting production functions, (3) data are expensive to gather, and (4) technical scientists are short of information on points of diminishing total and marginal returns, not to mention information on the effects of fertilizer placement, antibiotics, hormones, etc., on growth rates. Econometricians can help with two of these four problems.

Another group of studies to be mentioned involves the value productivity functions that have been fitted to cross sectional data on farm firms. Three types of data have been used in such studies: farm record data produced by the farm accounting services of different land-grant colleges, survey data from randomly selected farms and survey data from purposely selected farms.[17] In general, the mathematical function used in these studies has been the Cobb-Douglas. Such studies have yielded

[17] For examples of these three type of studies, see: G. Tintner and O. H. Brownlee, "Production Functions Derived from Farm Records," *This Journal*, Vol. 26, 1944, pp. 566-571; Earl Heady, "Production Functions from a Random Sample of Farms," *This Journal*, Vol. 28, 1946, pp. 989-1004; and Glenn L. Johnson, *Sources of Income on Upland McCracken County Farms, 1951*, Progress Report No. 2, Kentucky Agricultural Experiment Station, 1952.

rather conclusive estimates for purposes of general policy recommendation of the marginal value productivities of categories of inputs. More recently, the results of such studies have been used in recommending general reorganizations for individual farms. The principal studies carried out in this area have been done at Iowa, Kentucky, Montana, North Carolina, North Dakota, Michigan, Illinois and Wisconsin. Here again, as in the case of the enterprise input-output studies, serious problems in statistical design arise that are as yet unsatisfactorily answered. Farm account samples have proven unrepresentative. They are also inefficient in estimating regression coefficients as the correlations among input categories are high. Random samples are also inefficient because of high correlations among the input categories. Purposive samples in which farms are selected so as to reduce correlations among input categories (without disturbing the distribution of gross income about its relationships to the input categories) have been more efficient for estimating regression coefficients but are, of course, very inefficient for estimating means, variances and correlation coefficients.

One of the early analytical and computational techniques developed by empiricists in farm management was budgeting. Farm management men have tended to employ linear input and output relationships in budgeting. Size of business has been determined by some limiting factor such as family labor, available capital or owned land. Production economists on the other hand, have tended to employ derivatives of continuous functions, wherever existence of adequate input-output data have made this possible.[18]

More recently, linear programming has been applied by production economists as an extension of formalization of earlier budgeting techniques. The most important results to date have been obtained by Fred Waugh in devising optimum rations for dairy cows; by Clifford Hildreth in designing rotations; by Walter Fisher and Leonard Schruben in adjusting feed mixtures for price changes; and by workers at the North Carolina Station.[19]

In earlier farm management budgeting work, two problems arose to plague investigators. The first of these was a shortage of data reflecting

[18] For a detailed account of how this is done, see L. A. Bradford and G. L. Johnson, *Farm Management Analysis*, John Wiley and Sons, New York, 1952, pp. 334-360.

[19] Frederich V. Waugh, "The Minimum Cost Dairy Feed," *This Journal*, Vol. 33, 1951, pp. 299-310; Clifford Hildreth and Stanley Rester, "On the Choice of a Crop Rotation Plan," *Activity Analysis of Production and Allocation* (John Wiley & Sons, New York), 1951, p. 177f; W. D. Fisher and Leonard W. Schruben, "Linear Programming Applied to Feed-Mixing Under Different Price Conditions," *This Journal*, Vol. 35, 1953, pp. 471-483; and Richard A. King, "Some Applications of Activity Analysis," *This Journal*, Vol. 35, 1953, p. 823f.

the actual impact of the law of diminishing returns. The other problem was that of pricing fixed assets. In one sense linear programming handles the economies of fixed asset utilization without requiring the pricing of fixed assets. In another sense it does not because a production process may be found that yields a marginal value product for a fixed asset in excess of its acquisition cost, in which case it pays to vary the asset thus destroying part or all of the fixity required in linear programming to set an upper limit on the size of business. A start in the direction of handling this type of problem has been made by Victor Smith, of Michigan State College, who has programmed certain beef producing activities with a discontinuity in corn but, unfortunately, not in land or labor prices.

Linear programming in agriculture also suffers from a lack of suitable input-output data. Systematization of budgeting into linear programming does not get around data limitations. Diminishing returns are commonly handled by programming different points on the production function as separate activities. Production economics research indicates that curvilinear functions are the rule, not the exception, in agriculture. Thus it may be that the number of activities that will have to be programmed as our input-output data improve will increase to the point where the programmer may seek derivatives of continuous curvilinear functions in self-defense.

Mention should be made of accomplishments in the macro and semi-macro area of agricultural economics. The typical farm studies of the old Division of Farm Management and Costs of the Bureau of Agricultural Economics have yielded valuable empirical insights into the impacts of price and technological changes on many different types of farms. The profession has been furnished with valuable indexes of agricultural productivity by the work in B.A.E. of O. C. Stine and his associates. Other work of importance includes the Work Progress Administration indexes developed by Bressler, the National Bureau of Economic Research indexes by Strauss, Barger and Landsberg and, finally, the output indexes developed under Sherman Johnson. The productivity of agricultural labor has been studied repeatedly by dividing various productivity indexes by indexes of employment. More recently, Hecht and Barton, Haygood and Ducoff,[20] D. Gale Johnson, Wilcox and Hendrix have investigated labor productivity as it varies geographically and among types of farms.

Aggregative supply studies have been less satisfactory, both empirically

[20] Reuben W. Hecht and Glen T. Barton, *Gains in the Productivity of Farm Labor*, U.S.D.A. Technical Bulletin 1020, 1950; L. G. Ducoff and M. J. Haygood, *Differentials in Productivity and in Farm Income of Agricultural Workers by Size of Enterprise and Region*, Bureau of Agricultural Economics, U.S.D.A., 1944 (mimeographed).

and conceptually, than the micro-production economic work. More seems to have been said than done about studying interregional competition.[21] Much of the national supply response work has been done as a necessary step in carrying out price analyses. Cochrane,[22] D. Gale Johnson, Schultz, Galbraith and Black (to mention a few) have worked on the problem of the over-all supply function for agriculture. The situation remains vague, however, with many people arguing that the aggregate supply function for agricultural products is inelastic and, in important cases, negatively sloped.

As will be pointed out later, there is a feeling on the part of some members of the profession that a more thorough going conceptualization of dynamic production economies at the micro level, at the macro level and especially with respect to the interrelations between the two is required to guide empirical work. Again, econometricians have much potential aid to offer.

We are now at the point where we must discuss dynamics.

Dynamics–the Weak Point of Both the Heirs and the Unendowed

The early classical theorists worked with dynamic problems. As economic theory developed, however, there was a tendency to employ simplifying assumptions to remove disturbing dynamic influences.

Similarly, empirical farm management workers started with dynamic problems but found it advantageous to abstract from the bothersome dynamic changes of the real world. They employed long-run averages and concepts of normal prices and yields, in budgeting, planning, establishing accounting charges for fixed assets and in devising public farm credit policies.

Both groups developed a sharp distinction between the firm and household. Both failed to explain how management operates, what it does or how it earns its pay.

General economists, since Knight's *Risk, Uncertainty and Profit*[23] was

[21] For a notable exception, see R. L. Mighell and John D. Black, *Interregional Competition in Agriculture: With Special Reference to Dairy Farming In the Lake States and New England*, Harvard University Press, Cambridge, 1951. Also, see a review of this book, by the author of this paper, in the *Journal of Political Economy*, Vol. LX, p. 184, for a discussion of how econometricians can contribute to this type of study.

[22] Willard W. Cochrane, "Farm Price Gyrations–An Aggregative Hypothesis," *This Journal*, Vol. 39, 1947, p. 383f; D. Gale Johnson, "The Nature of the Supply Function for Agricultural Products," *American Economic Review*, Vol. 40, 1950, p. 539ff.; T. W. Schultz, *The Economic Organization of Agriculture*, (McGraw-Hill Book Co. Inc., New York), 1953; and J. K. Galbraith and J. D. Black, "Maintenance of Agricultural Production During Depression: the Explanation Reviewed," *Journal of Political Economy*, Vol. 46.

[23] Frank H. Knight, *Risk, Uncertainty and Profit*, Houghton Mifflin Company, Cambridge, England, 1921.

published, have given increased attention to profits and managerial processes. More recently the land-grant system has also been concerned with how information on improved farm practices spreads, the nature of management and the interrelationships between consumption and production in the total farm set-up. This interest within the land-grant system seems to have a triple origin. *First,* production economists and others acquainted with Knights' work sought applications of it in the fields of farm management and policy. *Second,* rural sociologists became interested in the way information on farm practices spreads. And, *third,* extension service workers, particularly in southern states such as Missouri and Kentucky, became impressed with the managerial interrelationships between the firm and household aspects of the farms with which they were dealing. Closely related to the extension experience are the experiences of the Soil Conservation Service, the Farm Security Administration and the T.V.A. test demonstration program.

Currently this interest is further stimulated by large scale appropriations to the extension service for purposes of carrying out a joint farm business and home planning approach to extension. Although production economists are happy to see Congress take this big step forward, they deplore the fact that sufficient research on managerial economics has not yet been done; the concepts are still fuzzy and empirical work is extremely scanty. Agricultural production economists cannot say they were not warned. In 1939 T. W. Schultz wrote a fundamental article pointing out that farm management research was failing to provide results of use to individual farmers under dynamic conditions.[24]

Schultz also pointed out that farm management was failing to provide results of use to policy makers in understanding the relationship between micro and macro adjustments in agriculture. Although fortunately many agricultural production economists have taken his statement seriously and have given considerable attention to the problem of developing and applying dynamic economic theory to agricultural production problems, the current juncture of dynamic micro-economic thought in general economics with the experience of the land-grant system and federal agencies with management-orientated, action programs has created a need we are unable to fill. Modern managerial concepts still sound strange in the ears of extension personnel, many of whom have little economic training, but are, nevertheless, administrators of the whole farm unit approach to extension. Thus a substantial number of farm management men and production economists watch very eagerly the current developments in the theory of decision making to which econometricians are contributing so much. At least three recent books in agricultural

[24] T. W. Schultz, "Theory of the Firm and Farm and Management Research," *This Journal,* Vol. 21, 1939.

economics and several experiment station bulletins contain expository treatments of the subject.[25]

As a production economist reads the literature being produced by mathematicians and mathematical economists on the decision processes, he becomes aware of a rather fundamental distinction between their work and work being done by agricultural economists. The agricultural economists, by and large, are on the firing line in the sense that they have to teach coordinated courses in farm management or work with extension people who have to stay coordinated in their presentations to farm people. Econometricians concentrating on research do not experience this continual need for coordination. This permits them to concentrate rigorously upon minute aspects of the decision-making processes. This involves some danger of over-abstracting and of failing to integrate and uniformly develop managerial theory. On the other hand, the agricultural economist, under the pressure of teaching and extension work, strives continuously to maintain the coordination required to teach farm management by gleaning from the ideas of such people as Abraham Wald, Raiffa, Bush, Von Neuman, Morgenstern, Tintner, Marschak, Katona and others those concepts that can be incorporated into farm management teaching without destroying the structure. This procedure on the part of the agriculturalists, although being less rigorous, remains less abstract and yields a more realistic and integrated product.

The first group of empirical studies in agriculture utilizing dynamic theories had to do with price expectations. These studies were carried out under T. W. Schultz's leadership by Brownlee, Gainer and others.[26] Some time later, D. B. Williams at the University of Illinois carried out another price expectation study.[27] At North Dakota, Phil Thair and others, under the leadership of Rainer Schickele, have studied the impact of yield and

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[25] E. O. Heady, *Economics of Agricultural Production and Resource Use*, Prentice-Hall, New York, 1952, pp. 439-562; L. A. Bradford and G. L. Johnson, *Farm Management Analysis*, John Wiley and Sons, New York, 1952, pp. 3-37 and 365-411; E. O. Heady and Harold R. Jensen, *Farm Management Economics*, Prentice-Hall, New York, 1954, pp. 515-550; and G. L. Johnson and C. B. Haver, *Decision Making Principles in Farm Management*, Kentucky Agricultural Experiment Station, Bulletin 593, 1953.

[26] O. H. Brownlee, and W. D. Gainer, "Some Considerations on Forward Prices," *This Journal*, Vol. 25, pp. 495-504; O. H. Brownlee, "Farmers Price Anticipations and the Role of Uncertainty in Farm Planning," *This Journal*, Vol. 31, pp. 266-75; T. W. Schultz, "Theory of the Firm and Farm Management Research," *This Journal*, Vol. 21, pp. 570-86; "Capital Rationing Uncertainty and Tenancy Reform." *Journal of Political Economy*, Vol. 48, pp. 309-24 and "Two Trials to Determine Expectation Models Applicable to Agriculture," *Quarterly Journal of Economics*, Vol. 56, pp. 487-96.

[27] D. B. Williams, "Price Expectation and Reactions to Uncertainty by Farmers in Illinois," *This Journal*, Vol. 33, pp. 20-39.

income uncertainty on farm business.[28] At an earlier date, Carl Heisig made studies on the influence of price and yield functions on the net worth of a typical Montana wheat farm.[29] More recently the mathematics of expected variances in combining risky enterprises has been investigated at Ames and attempts made to estimate the main components of the resultant variance formulas. This work is well summarized in a bulletin by Heady, Kehrberg and Jebe.[30]

More recently, managerial concepts of use to farm managers have been brought together in an expository bulletin prepared under the sponsorship of the North Central Farm Management Research Committee.[31] At Kentucky some work was done on case study farms to determine how the managerial processes are employed by farmers. As an outgrowth of these case studies, a pilot study of managerial processes used by farmers was carried out on some 31 farms in Montgomery County, Kentucky.[32]

A work conference on Risk and Uncertainty was held at Bozeman, Montana a year ago by a group of farm management men and production economists. At this conference an attempt was made to draw together the concepts that might be useful (1) in studying the managerial processes under conditions of risk and uncertainty and (2) in making social adjustments to risk and uncertainty. Two approaches to empirical work on the managerial process seemed to evolve at the Bozeman conference. One of these involves pursuit of objective data on price and yield variation while the other turns to a study of the more subjective aspects of the managerial process.

Partially as a result of the Bozeman conference, a seven-state managerial study was undertaken to study in detail the managerial processes of farm managers. This study is based in part of the preliminary pilot study at Kentucky. Indiana, Iowa, Kansas, Kentucky, Michigan, North Dakota and Ohio are cooperating in the study which examines types and sources of information and thought processes used by farmers as well as the different states of knowledge they hold, the strategies they employ and the utility they attach to gains and losses in income. This study of

[28] Rainer Schickele, "Farm Business Survival Under Extreme Weather Risks," *This Journal*, Vol. 31, pp. 931-43 and "Farmers Adaptations to Income Uncertainty," *This Journal*, Vol. 32, pp. 356-74.

[29] C. P. Heisig, "Income Stability in High Risk Farming Areas," *This Journal*, Vol. 28, pp. 961-72.

[30] Earl O. Heady, Earl W. Kehrberg and Emil H. Jebe, *Economic Instability and Choices Involving Income and Risk in Primary or Crop Production*, Agricultural Experiment Station, Iowa State College, Research Bulletin 404, January, 1954.

[31] Glenn L. Johnson and C. B. Haver, *op. cit.*

[32] Glenn L. Johnson, *Managerial Concepts for Agriculturalists, Their Development, Present Status, Shortcomings and Usefulness*, Kentucky Agricultural Experiment Station, Bulletin, 1954.

some 1200 single-family, farm managerial units is just now being coded for IBM tabulation.

Theory of games applications for handling risks were not considered at the Bozeman conference. In fact, such applications appear virtually non-existent in the field of agriculture though they appear to hold great promise (1) as guides to managers in handling certain personnel problems and (2) in devising strategies to employ in handling yield and price uncertainties.

Schultz's admonition to consider dynamic economics has also been taken seriously by persons doing policy research bearing on production. However, the work has primarily involved application of existing dynamic theory and not conceptualization despite severe limitations imposed by inadequate macro and semi-macro dynamic concepts. The forward pricing idea developed by D. Gale Johnson[33] is a straight forward application of Knight's work as scantily modified by Hart and Tintner. Two pieces of research tend to bear out the conclusion that the elimination of price uncertainty increases the efficiency with which the economy can be operated. One of these is the burley tobacco research carried out at the University of Kentucky; the other is the study of the potato support price programs done by Cochrane, Gray and Sorenson at the University of Minnesota. A third similar study of dry beans being completed by Dale Hathaway at Michigan State College[34] does not support the "forward pricing idea" directly. In addition, a North Central Regional Research Committee on Agricultural Policy is sponsoring several studies, including an examination of the wheat and dairy price programs, that should throw some light on pricing policies.

The possibilities of devising public policies and programs to eliminate yield risks have been investigated by Halcrow in his work on crop insurance.[35] Hendrix has also looked tentatively at some of the policy problems created by technological change.[36]

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[33] D. Gale Johnson, *Forward Prices for Agriculture* (The University of Chicago Press, Chicago), 1947.

[34] Glenn L. Johnson, *Burley Tobacco Control Programs—Their Over-all Effect on Production and Prices, 1933-50,* Kentucky Agricultural Experiment Station, Bulletin 580, 1952; James Thompson, *Inter-Farm and Inter-Area Shifts in Burley Tobacco Acreage Under Government Control Programs,* 1933-50, Kentucky Agricultural Experiment Station, Bulletin 590, 1953; R. W. Gray, V. L. Sorenson and W. W. Cochrane, *An Economic Analysis of the Impact of Government Programs on the Potato Industry,* University of Minnesota Agricultural Experiment Station, Technical Bulletin 211, 1954; and Dale Hathaway, *The Effects of the Price Support Program on the Dry Bean Industry in Michigan,* Michigan Agricultural Experiment Station, Technical Bulletin (in Process), 1955.

[35] Harold G. Halcrow, "Actuarial Structures for Crop Insurance," *This Journal,* Vol. 31, 1949, pp. 418-443. This well footnoted article will lead the econometrician to much of the crop insurance work done by agricultural production economists.

[36] W. E. Hendrix, "Availability of Capital and Production Innovations on Low Income Farms," *This Journal,* Vol. 33, 1951, pp. 66-74.

Another area of interest is the process of aggregating individual preferences into social choices involving agricultural production. Farm management men, after years of dodging such issues, now face them squarely in the whole farm unit approach in extension. Perhaps unacceptable, inconsistent, personal preferences, and poor aggregation of such preferences into family choices that are social, account for more farm failures than poorly executed and planned production operations. The agricultural production economist addressing himself to policy questions encounters the same problems at the public policy level as at the private policy level. The discussions, at the Bozeman work conference, of social means for handling risk seemed to flounder repeatedly on problems of aggregating individual preferences into social choices. Another example is the work of the North Central Farm Management Research Committee on the economics of soil conservation. This committee has been concerned with "Pareto-better" adjustments that farmers can make in the interests of soil conservation for about six years without ever addressing itself to the basic conflict between individual preferences and the social choice reflected in our soil conservation legislation.[37] The work of the same committee on the "diverted acreage" problem bears a similar orientation and has succeeded equally well in evading the basic problem, which is again one of individual preferences in conflict with a group choice. Here are real opportunities for Arrow,[38] Hildreth,[39] Raiffa and Bush to illustrate the applicability of their work.

Analytical Problems

As we examined the results of agricultural production economics research, several problems that econometricians and/or mathematical economists could help us solve were noted and discussed. Some of these were rather mundane for the modern mathematician or statistician, others were fundamental and capable of challenging the best efforts of the best minds in the country.

Among the more mundane problems mentioned were those having to do with appropriate equations to use in estimating production functions and sample designs. The main production functions that agricultural production economists have used are the Cobb-Douglas, Spillman and various polynomials. These and additional functions need to be examined systematically so that their characteristics, from the standpoint of economic analysis, are more clearly and generally known. One characteristic

[37] L. A. Bradford and G. L. Johnson, *Farm Management Analysis* (John Wiley and Sons, New York), 1952, p. 429.

[38] K. J. Arrow, *Social Choice and Individual Values* (John Wiley and Sons, Inc., New York), 1951.

[39] Clifford Hildreth, "Alternative Conditions for Social Orderings," *Econometrica*, Vol. 21, 1953, pp. 81-94.

that is of particular interest has to do with the ease with which the basic input-output data can be transformed to eliminate the shortcomings of these functions. For instance, various transformations on the yield data used in a Cobb-Douglas function can destroy its constant elasticity characteristic with respect to the untransformed data. Other transformations on input data for the same function can destroy its symmetry and introduce ridge lines to correspond with production responses actually encountered. The statistical design problems that bother production economists in their relationships with agronomists and animal husbandrymen have to do with replication and plot layout for experiments expected to furnish data for estimating surfaces as contrasted to points, averages and variances. Similar design problems arise when the survey method is used to gather cross sectional data for constructing marginal value productivity estimates. However, another problem arises. The high correlations that exist among input category data reduce the reliability with which regression coefficients can be estimated. This problem can be handled if studies are designed to eliminate such correlations. Such designs, however, reduce the reliability with which means, correlation coefficients and standard errors of regression coefficients can be estimated.

Several theoretical developments are needed to further the application of production economics, both dynamic and static to agriculture. One group of theoretical concepts which is the source of much difficulty appears to be the concept of fixed assets. It is becoming increasingly clear that assets remain fixed in a farm business so long as their expected value in their present use does not exceed the cost of getting more and does not fall below what could be realized for them if they were diverted to an alternative use. As the difference between replacement and opportunity cost is often very wide for agricultural inputs, assets once committed to an agricultural production process may remain in that process while their earning powers vary widely as a result of changes in prices and technology. This situation introduces very important problems in defining lengths of run and hence in isolating unique cost and supply functions. The various quasi-rents arising in this connection are difficult to handle as they appear negative if figured with respect to replacement costs and positive if figured with respect to salvage value. As so much of the inherited static theory assumes perfect markets with replacement equal to salvage prices, a revision of the theory is needed to take this departure of theory from reality into account. This problem has also created one difficulty after another in the work of the more empirical farm management workers as they have worked with farm business records and costs. The mathematical economist is in a position to do a particularly good job of reforming this theory. Just intuitively, it appears that linear programming may have something to offer in this connection.

Whenever quality is a product, utility analysis is important to production economists. Thus the problem of measuring utility offers an important opportunity for econometricians to aid us.

The theoretical basis for doing work on dynamic economics is not nearly complete enough. In this area, the econometricians have been particularly active. I refer now to the work on utility theory, decision making and social choices being carried out by such people as Friedman, Savage, Arrow and Bush. One of the most difficult aspects of dynamic theory that needs to be developed for the benefit of people working on farm management and production policy problems has to do with inter-relationships between economic theory, on one hand, and value theory, as conceived by philosophers, on the other. Security, liquidity, honesty and income for instance, have utilities to entrepreneurs that must be reckoned in understanding and advising farm managers. In fact, successful farm reorganization often requires development or adjustment of the value systems determining utilities. Study of these utilities involves gathering and handling highly subjective data. Econometricians as well as psychologists and sociologists can be of real help in developing methodologies for handling subjective data. If agricultural production economists are to maximize their net contribution to an extension program, such as the farm unit approach now being carried out, they must not ignore this problem. This is the problem of forming private policy, of creating and aggregating individual wants and preferences into a policy for the farm family.

Like the farm management men, persons concerned with public policies affecting production face problems of social choices and aggregation of individual wants and preferences. Soil conservation, rural poverty, rights to produce commodities whose prices are supported, publicly supported research and adult education in agriculture, public agricultural credit and rural electrification, to name only a few, are phrases that bring to mind questions whose answers are found in a process of aggregating individual wants and preferences into social choices. In this process, dollars, votes, strategic position, authority and moral convictions all play roles that we need to understand better.

The next area of dynamic theory that agricultural production economists need to have developed has to do with that never-never land between micro dynamics on the one hand and macro dynamics on the other. This is the area in which D. Gale Johnson worked on forward prices. If agricultural economists are to explain supply functions in a dynamic world, they need a much more semi-aggregative dynamic economics to guide thir work. Inasmuch as individual production responses are tied so closely to risk, uncertainty, preferences for security, liquidity and social status, industry supply responses are related to the same factor. At

the macro level Keynesian theory is evolving into something more or less capable of handling these factors, but at the industry and sector levels in which the agricultural production economist works such theory is virtually non-existent.

I should make one other point in closing. The references I have selected probably tend to be biased toward the work with which I am most familiar. Thus, I must apologize to authors I have omitted. I hasten to point out, however, that the footnotes in the references cited will in turn lead the reader to almost the entire body of literature in agricultural production economics.

SAMPLE SURVEYS AND EXPERIMENTAL DESIGN

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THIS paper discusses some of the problems encountered in attempts to find a more accurate approach to forecasting human behavior in the market place. Specifically it deals with problems of identifying and measuring the effects of certain variables on the volume of consumer purchases of individual products and services. These problems are of much interest to men in the commercial field who are attempting to find means of gaining competitive advantages. Only preliminary and partially satisfactory solutions have been found for the various problems discussed. In fact the purpose of problem identification is one of seeking to intensify the search for solutions by appropriate specialists.

There are those of us in public institutions who have been criticized by fellow workers for taking the individual commodity approach to market development. Our critics argue that there is no economic gain in finding more attractive ways for selling one product or service because it merely serves to shift demand from one product to another. They support their argument for food products by pointing out that the size of the human stomach has physical limitations. To be consistent in following this reasoning, I maintain that they must also condemn all commodity research in *production* as well as marketing. Certainly the same end is reached either through the discovery of a lower cost insecticide for peaches or a more attractive package for the same product. Either development satisfies wants more cheaply or more completely. These critics instead appear to accept shifts in production resulting from technological development as evidence of economic gain while at the same time they refuse to concede that shifts in consumptive patterns resulting from new marketing techniques can have economic significance.

Too many among us, who have accepted the validity of the commodity approach, have limited efforts to price analysis. Of all the motivating factors in the behavior of man that are manipulative, price is not the only one worthy of the economist's attention. While price is important, its manipulation often offers one of the least satisfactory solutions to a marketing problem.

Farmers and other businessmen, confronted with the practical every day problem of gaining competitive advantage in the market place, have long recognized the precarious premises on which many marketing decisions are made. They recognize the need for a more scientific approach in the decision-making process. But their experience with professional marketing research has yielded little, if any, more than is gained through

their own intuitive processes. Marketing research will gain stature only when it produces more reliable techniques for forecasting consumer reactions to given products, practices and services.

Consumers' purchasing decisions are based on an endless array of motivations, both conscious and unconscious. Although people usually have vocally expressible preferences for certain goods and services, it does not logically follow that behavior in the market place will be guided by such preferences. The vast multitude of preferences that enter into every decision-making process make it practically impossible to properly evaluate the intensity of each and every preference.

It is in such an environment that the marketing researcher has attempted to probe the minds of consumers constantly hoping through some device to come up with the "right answer." In this same environment the businessman must make decisions concerning what goods and services to offer the buying public. Often seemingly unimportant decisions such as package color, design or size, will shift large sectors of the market from one product to another. How then is he to decide how his product is to be priced, displayed, promoted, advertized and distributed? What resources are at his disposal in making his product more acceptable in order to gain competitive advantage and, from our point of view, to thereby make an added contribution to the satisfaction of human wants.

Conventional Approaches

Conventionally the problem has been studied by correlating identified changes in practices with trends in sales or by using probability sample surveys in which reported practices are related to indicated sales response. In this approach, the heterogeneity of conditions in the market place makes it virtually impossible to eliminate the numerous confounding effects. Even if the effects of major non-test variables sometimes can be satisfactorily eliminated through statistical devices, it must still be recognized that the historical or survey approaches are limited to measuring the effects of only those factors already commonly manipulated by the trade.

The conventional approaches offer practically no solution to the really live questions in marketing, those that deal with the effects of either unusual or innovated practices. Thus the commonly used techniques are restricted to the measurement of the effects of predetermined variables. Research devices in marketing should be capable of using observed phenomena for the purpose of developing new practices not previously conceived from other sources. Thus we are looking for techniques that will: (1) Provide a relatively satisfactory means of isolating the effects of specific variables tested under actual market conditions. (2) Permit the

testing of both existing and non-existing practices with equal facility. (3) Contribute in itself to the development of new and improved practices.

Using Experimental Designs in a Revised Approach

Controlled experimentation used successfully and extensively in other disciplines offers much in the way of meeting these needs. The author in 1948 initiated a series of controlled experiments in retail stores. This series to date includes some 60 different experiments conducted with a variety of designs and products. The results of many of the tests have been used by the trade over sufficient time to permit partial evaluation of the procedures under applied conditions.

In conducting retail store experiments, time and store differences represent two major independent sources of variation. Both sources can be controlled by "match lot" experiments in which some product varying only in the characteristic being tested is offered in a series of paired displays. Results are measured in terms of relative volumes sold. Unfortunately such a design creates a highly artificial situation. Relative sales from the various lots fail to indicate what sales would be if only one of the alternatives were offered, in spite of the fact that such determination is the implied purpose of the experiment. Spurious inferences are produced by matched-lot experiments because preferences of minor intensity are given an opportunity of exerting excessive influence. To produce results that can be relied on by the trade, not only must the method permit isolation of the effects of certain variables but also it must provide for testing specific variables under precisely the same environment that will prevail in application. The independent testing of alternatives in a particular environment complicates the problem of maintaining adequate controls over time and space (stores).

The latin-square design of experiment or some modification of it appears ideally suited for controlling time and store differences. Six years of experience in the development and use of such designs has demonstrated their value in marketing research.[1] This approach, however, also has some problems. These fall into five major areas: (1) Problems of choosing samples that will permit interpretation and generalization. (2) Problems of measuring short-run carry-over effects. (3) Problems of measuring a

[1] The details of various designs and the study results have been reported in bulletin form and journal articles, chief among which are the following: Methods of Research in Marketing, a series of four mimeographs describing the techniques of controlled experimentation, issued by the Cornell University Agricultural Experiment Station. Max E. Brunk and Walter T. Federer, Experimental Designs and Probability Sampling in Marketing Research, *Jour. of Amer. Statistical Assoc.* Sept. 1953, Vol. 49, pp. 440-452. Max E. Brunk, Controlled Experiments in Retail Merchandising, *This Journal*, Dec. 1953, Vol. XXXV, No. 5, pp. 916-923.

limited number of long-time effects. (4) Problems of selecting treatments in an orderly and logical fashion. (5) Problems of adapting covariance analysis to the processing of results.

Making Generalizations From the Experiments

Two different experiences will serve to illustrate problems of interpretation and generalization. In one instance the problem is that of interpreting the data from experimental results so that it will be meaningful in terms of actual marketing practices. The other is that of establishing confidence limits within which predictions from experimental results can be made in both time and space. The former is illustrated by a study of the effect of bruising on the sale of apples.

In this instance the survey method might have been a satisfactory tool because apples varying in the practical extremes of bruising were to be found in the market place. But from survey data it would have been difficult, if not impossible, to isolate the effects of bruising from the many other variables at play in the market. Also in this instance chief concern was with measuring the effects of bruising at its extremes as well as at points of common occurrence. Controlled experimentation offered an efficient approach to the problem of isolating and measuring the effects of extreme occurrences.

In the experiment four lots of apples were selected from a common picking so that they were comparable in all respects. Each lot contained 800 bushels and was intentionally bruised to prescribed levels so that bruising was the only variable among the lots. These lots were then used as treatments in a series of 4×4 latin squares covering 12 stores in 12 cities over a 3-month period. The experiment adequately measured the effects of the four selected levels of bruising but the results were of little utility without a knowledge of how the various test-lots compared with apples being offered in the market. To determine the latter it was necessary to conduct a sample survey of the amount of bruising on apples normally sold in stores. This was done using a probability sample covering 504 stores in the same 12 cities. Thus only by combining the controlled experiment with a sample survey was it possible to translate the experimental results into suggestions for changes in trade behavior. As it turned out only two per cent of the apples in the sample survey were bruised badly enough to adversely affect sales according to the results of the experiment. The study thus suggested little change in present practices. The effect of bruising on sales hardly could have been determined conclusively by a survey alone because so few apples offered for sale were bruised badly enough to modify consumer behavior.

Not nearly as satisfactory a solution has been found to the problem

of choosing stores to be used in a controlled experiment. Common concepts of an adequate sample are difficult to translate from that required in the survey approach to the controlled experiment because the experimenter exercises control over a vast array of non-test variables. At the same time any experiment is greatly restricted in coverage through cost considerations. To date most experiments in food marketing have been confined to self-service chain stores and likewise generalizations of findings have been limited to such outlets. Even so there is much danger that the limited number of stores in which an experiment can be conducted will not provide a statistically reliable basis for generalization even within this limited universe. This is particularly true of designs in which the researcher seeks to minimize store variance by limiting the experiment to the outlets of one firm. Limited experience indicates that the need for such restriction is more imaginary than real. At the same time one must recognize that there is a striking uniformity among the products handled in food stores across the nation, particularly in the national chains. Even so there are differences among stores in different firms, in large and small cities, in high and low income areas, in geographic regions and the like.

Although the analysis of variance provides the researcher with unbiased estimates of the causes of variance within a particular experiment, it does not provide an adequate basis for generalization. Judging from recently published studies, which represent pioneering effort with controlled experimentation in agricultural economics, the authors appear to demonstrate some confusion in the use of tests of significance. There is a thread of implication that the F-ratio provides confidence limits for generalization. Such spurious inference might well hinder the development of a very useful tool.

Estimates of sampling adequacy in controlled experimentation can be derived best through the repeated application of a given design over both time and space. Unfortunately few experiments in agricultural economics have yet reached that stage. Even so the final test of the validity and usefulness of any research is the experience of application. Results from a series of apple merchandising experiments together with the widespread application of findings indicate that a surprisingly high degree of reliance can be placed in the results obtained from a relatively small experiment. Future experience with other products may temper such conclusion. The author's experience has been limited to such products as apples, peaches, dry beans, lettuce, tomatoes and cut flowers.

The apple experiments were conducted over a four-year period of widely varying prices. In the first year the tests were made in four small New York villages the second year in twelve New York cities of medium size, the third year in three small villages and last year in Pittsburgh,

Pa. The experiments were conducted in the stores of four different chain organizations. In the series of experiments, a number of comparable merchandising practices were tested, although some of the least successful practices were not retested during the last two years.

Time will not permit a detailed examination of the results (available from other published work) but the striking similarities in the results obtained in all tests, under the variety of conditions described, indicate that predictions can be made safely from experiments conducted in a very small number of food stores. For example, 7 latin square experiments were conducted over this time, in which the sales effectiveness of two types of prepackaging material were compared. In each test the same material yielded a sales advantage ranging between 5 and 15 per cent. In each of three years, tests were made of a range in the units for which price was quoted (i.e. 2 lbs. for 30¢, 3 lbs. for 45¢, etc.). In each year sales were maximized with the same size unit. Similar experience was had for treatments concerned with size of display, color of package and displays of bulk versus prepackaged fruit.

Since the first of these experiments was conducted in 1950, there has been widespread adoption of their results throughout the United States. Within several years better than half the supermarkets had modified their merchandising of apples in partial or complete conformity. While acceptance by the trade does not prove the accuracy of generalization, it does support it. Other practices, which did not respond well in the New York tests might possibly have yielded greater results in other geographic areas, but the general adoption of the experimental results suggest that they at least offered competitive advantages over older practices in most parts of the United States. In this instance time and experience have clearly helped to determine how widely generalizations might be made from experiments.

Measurement of Carry-over Effects

Because the rotation of treatments in the latin square creates an artificial condition not normally found in the market place, some manner of measuring the effect of rotation is desirable. In a rotational design some arbitrary decision must be made concerning the length of time a treatment should be tested in any one store. In the interest of efficiency, it is desirable that such periods be as short as possible, recognizing that they must be of sufficient length to provide reliable estimates. Unfortunately, adequate criteria for determining optimum length of rotations are lacking. The weekly shopping pattern of food stores possibly suggests weekly or multi-weekly rotation of treatments. A series of treatments were compared in 24 experiments using daily rotations and in 10 experiments

using weekly or biweekly rotations. There was no difference in the ranking of the treatments in order of sales response although the coefficients of variation were higher in the 24 experiments.[2] Even so there is probably little justification in rotating treatments in food stores more often than once a week while no particular advantage has been demonstrated with bi-weekly rotations.

Weekly rotations of certain treatments in grocery stores where a large proportion of the clientele returns each week may create the problem of measuring the effects of preceding treatments on other treatments immediately following. A measurement of this kind may be made with the double change-over design in which treatments are compared in various sequences in $k - 1$ orthogonal $k \times k$ latin squares. Care must be taken that the length of rotation allows such effects to stem only from the immediately preceding treatments. Here again assumptions must be made concerning shoppers' behavior patterns.

If several replicates of an experiment are to be carried out the double change-over design offers good insurance. It retains the advantages of the latin square and at the same time permits detection of carry-over effects so that correction can be made in the treatment means. If no carry-over effects are present the individual squares may be used independently. Concern with carry-over effects arises when one of a number of treatments is a particularly "good buy" or when testing the effects of such things as quantity offerings which logically may yield carry-over influences. In no way should the measurements of carry-over effects be confused with the measurement of long-time effects.

Measurement of Long-Time Effects

Some researchers have criticized the rotational designs of experiment for failure to measure the long-time effects of treatments. Certainly such criticism is valid, but obviously that does not negate the value of such designs for other purposes. Rotational designs are efficient in the exploratory work of testing the effects of many alternative treatments some of which may hold promise of long-time influence. In merchandising there are many novel practices that may result in short-lived response. Some degree of judgment certainly needs to be exercised in the selection of treatments in order to isolate those holding promise of long-time influence. Certainly, however, the identification of a potentially influential treatment is far more important in market development than that of

[2] In the 24 experiments rotated daily the coefficients of variation ranged from a low of .198 to a high of .535. In the 10 experiments having longer rotations the coefficients ranged from .061 to .223. The coefficients were computed from the residual mean squares without covariance.

simply measuring how lasting such effects might be. Once promising treatments have been sorted out or developed they may be tested in other types of experimental designs adapted to measuring effects over any particular length of time desired.

In the apple experiments one particular practice, among some 30 different ones tested, repeatedly maximized sales. In this instance there were practically no cost advantages offered by the alternative practices available. There was little need for measuring the comparative duration of effects, aside from the slight possibility that sales with the new practice might diminish over time to a point *below* those resulting from the original practice. To explore this possibility the new practice was compared with the old in a paired panel of stores over a three-month period. Results in the controlled experiment yielded a 40 per cent increase in sales. Results in the "long run" test yielded a 42 per cent increase in sales. Greater confidence in "long run" effects of the new practice was provided by week-to-week comparisons throughout the three-month period in which there remained a constant relative advantage. A marked change in relative advantage over the test period, of course, would have prompted extension of the test.

Orderly Systems of Treatment Selection

The selection of treatments in an experiment is the most important decision that must be made. Obviously the controlled experiment may be used to measure the effects of preconceived treatments, but thus limited the experimental method offers relatively little advantage over other approaches. The agricultural economist has used controlled experimentation almost exclusively for the purpose of testing the effects of alternative treatments preidentified from other idea sources. Such unorderly selection of treatments ignores the most important contribution to be gained from experimentation. Controlled experimentation can offer the researcher an orderly means of identifying desirable modifications in treatments so that the test device itself contributes to the development of innovation. At the beginning of a series of experiments a start may be made with ideas borrowed from the trade or developed as initial hypotheses by the researchers with no decision being made concerning further possible treatments until initial tests are completed.

This procedure may be roughly illustrated by the 24 apple merchandising experiments conducted in 1950. At the outset, four treatments were selected for testing. These first selections were made intuitively, keeping in mind the possible later testing of orderly modifications of these particular treatments. The first experiment demonstrated that size of pricing unit and packaging materially affected sales and that point of sale advertising

did not. As a result, additional experiments were designed to test a series of different size pricing units on the sales of bulk apples. The optimum pricing unit was thus determined. Additional experiments tested different sizes of pricing units using the packaging material that yielded the best advantage. It was thus discovered that the optimum size unit for prepackaged apples was different from the optimum size in bulk. Analysis of this behavior showed that packaging offered shoppers the advantage of convenience, but offering only the size of package that maximized sales volume failed to maximize the *number* of sales. This observation, that some shoppers dropped out of the market when they could not buy smaller units than the package size offered, suggested a treatment of combined bulk and packaged apples. Again a series of tests was made to determine optimum size units for this derived practice, with the result that maximum sales were attained with a larger size pricing unit than when either bulk or prepackaged apples were offered alone. This new practice probably maximized total sales. Through pricing it suggested a large unit purchase. Through packaging it made purchases of that size unit convenient, but at the same time it made any size of purchase possible since it included bulk fruit. This selling scheme resulted from some orderly selection of treatments. It was the most effective of some 30 different practices tested. The sequential selection of treatments permitted innovation by allowing the actions of shoppers in the market place to guide the building up of the end product of research in an orderly way.

Rotational designs are well suited for such purposes but the researcher must be careful to make adequate tests throughout the process if he is not to be sent off on some unrewarding tangent. This justifies the use of short-time rotation tests, but at the same time it raises a question about the need of tests for longer-term duration. In the apple merchandizing described above the sequential selection of treatments was not formalized by mathematical rule, but there may be a need for the development of more precise techniques in this area. After measuring the effects of several modifications of a given variable, such as size of unit, price or color, it should be possible to logically select modifications for future testing in a way more efficient than trial and error. More complicated, but perhaps not insoluble, is the problem of selecting treatments on a sequential basis according to formulae among discrete variables.

Experience with Covariance Analysis

Although the latin square is an effective device for controlling time and store differences there is sometimes need for making adjustment in treatment means because of variations in some associated factor not controlled

by the design. In merchandising studies of individual products, covariance analysis may be used to adjust for such factors as number of customers, total store sales, or the total sales of the particular department in which the product is handled. In some 60 experiments with merchandising food products, however, analysis of covariance has been of very little value. In less than half the cases no efficiency was gained by its use. Actually the removal of time and store differences in the latin squares eliminates most of the relationship between the covariate and the test means, so that residual variations are not related to an appreciable extent. If a non-rotational type of design is employed such analysis may be expected to play a major role in decreasing error variance.

There is a possibility that covariance analysis might be useful in certain studies where there is reason to suspect the presence of the effects of treatments in test-stores on sales in non-test stores. For example, use has been made of rotational designs for measurement of demand elasticity. To accomplish this, a range in prices for a given product is offered in a group of test stores. It may be assumed that such a test yields two major types of shifts in purchase patterns. One is the shift in the purchase pattern among products within a given store (cross elasticity) and the other is the shift in purchases among stores. In the measurement of demand elasticity the researcher may wish to eliminate the cross-store effects because of their assumed artificiality. Covariance analysis, using sales of non-test stores as the independent variable, may be useful in adjusting for cross-store effects. Other considerations place reservations in the author's mind on the use of controlled experimentation for measurement of demand elasticity. Even so, the device offers a challenge to researchers in this area. For example the author in limited experiments on cut flowers observed large quantity responses to price increases but very little quantity responses to comparable price decreases.

Concluding Comments

There can be little question that in the short span of four or five years, controlled experimentation has established itself as a valuable tool in agricultural economics. The results of experiments are clear in their meaning to businessmen. This indeed must be a refreshing experience from the clutter of qualifications and irrelevantly observed phenomena that have characterized much economic research. In addition, experiments conducted in retail stores serve something of a dual research and extension role. Management, having witnessed the results of an experiment, seldom needs further demonstration of findings. This serves to expedite adoption of recommendations. In view of these advantages the researcher must be on guard not to over-simplify the meaning of experimental results or to make unwarranted generalizations.

Experience with experimental designs in agricultural economics to date has been largely restricted to orthogonal designs. This is probably because the pioneering effort employed the latin-square. Non-orthogonal,[3] factorial and other designs offer an almost limitless array of possibilities in tailoring a design to meet the problem at hand. Initiative in the development of new and more appropriate designs for dealing with economic phenomena is needed.

[3] For example, seven treatments may be very effectively tested in a 3×7 design in which each treatment occurs in each of three stores and over time in combination with all other treatments.

DISCUSSION

D. GALE JOHNSON
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Let me open my comments by very briefly giving my reactions to the three papers, after which I wish to discuss two points that come to mind because of statements in the paper by Glenn Johnson. Foote has provided us with a very useful summary of econometric work dealing with supply and demand conditions for agricultural products. The magnitude of the interest and the scope of the work in these problems is well illustrated by his survey. Since the last such survey was made in mid-1953 about twenty different articles or theses have been prepared. Not only has the number been large, but the quality of the work is, in general, of first order.

Brunk has described for us an interesting series of experiments that were designed to show the influence of various marketing activities on sales, and presumably on profits. While Brunk seems to be a little sensitive to the criticism of unnamed critics and occasionally engages in verbal battle with an unspecified opponent, there can be little question that Brunk has shown the real advantages of the use of certain experimental designs in tackling some of the management problems in the marketing of agricultural products.

Glenn Johnson's paper is much more than a survey; it also represents an effort to delineate the nature of the problems that must be faced if production economics is to be as useful as we hope it might be.

The first point raised by Glenn Johnson may come only from the choice of a word, yet I believe the matter to be of sufficient importance to devote a few moments to its discussion. A reference is made to the need for production economists to revise theoretical concepts if it is found that discrepancies occur between "reality and empirical solutions built on unrealistic theory." My quarrel here is with the presumption that some theory is unrealistic while other theory can be realistic. All theory is unrealistic; if it were not, it would not be theory.

There is a view, all too general I fear, that the goodness or badness, the rightness or wrongness of a theory can be determined on the basis of the realism of the assumptions of the theory. But this surely cannot be a satisfactory procedure. How can one determine whether the assumptions of theory A or B, both designed to explain the same phenomenon, are the more realistic? For

example, we wish to explain the output of a given crop in a certain area. Theory A and theory B are much alike in that both assume that there exists a given technological relation between inputs and output, specified supply functions for all inputs except that of the management and labor of the farm operator, and that the demand functions for this and other products are known. Theory A assumes that the farm operator wishes to maximize profits and this determines how much of his own energies he will use and how he will combine inputs in producing the different outputs. Theory B assumes that the operator wishes to maximize the utility he obtains from engaging in economic activity. Most might agree that the assumptions of theory B are more realistic than those of theory A. Even if we were to admit this, does this imply that we would use theory B instead of theory A? The answer may well be in the negative since theory A is simpler than theory B and it may give as accurate predictions as does theory B. In fact, theory B may give rather inaccurate predictions, compared with theory A, because of errors in the estimation of utility functions.

The second point is not a reaction to any statement made by Glenn Johnson, but results from the simultaneous receipt in the same day's mail of Johnson's paper and the most recent estimates of the farm population. In Johnson's paper is a statement that many people argue that the aggregate supply function for farm products is negatively sloped. The notion that the aggregate supply function has a price elasticity almost if not equal to zero (if not negative) is frequently used as an excuse for not being concerned about the level of farm price supports. Although I make no attempt to give chapter and verse, I suspect that many agricultural economists interpret the recent behavior of farm output and prices since 1948 as support for the notion.

Since 1948 agricultural output has remained approximately constant; the parity price ratio has declined from 110 to about 90. But a supply function should not be derived from output quantity and price data alone if we have knowledge that the supply function or demand function may have shifted. It is quite possible that what we have witnessed is a moving equilibrium of supply and demand. At least there is a strong presumption that everything that lies behind the supply function is not static and unchanging. In the four years following 1950 the farm population declined from 25.1 to 21.9 million. Even more striking, the number of males 20 to 24 declined by more than 34 per cent. In fact the migration rate of the male age group 15 to 19 in 1950 has been at least 50 per cent in a four-year period. As a consequence of the changes that have occurred in farm population there has been little change in the per capita level of real farm income since 1948. Income originating in agriculture has declined by almost a fourth since 1948, yet the decline in farm population and the increase in income from nonagricultural sources has left the per capita real income of the farm population at approximately its 1948 level. Since the 1948 level was the highest on record, it may well be that there has been a remarkable adjustment occurring that has gone almost unnoticed.

It may be noted that the experience of the last six years is as consistent with the hypothesis that the supply of labor to agriculture, under conditions of full employment, is very elastic. In saying this, it is assumed that labor has continued to receive the same share of total income produced in agriculture, a not very unreasonable assumption and one that is approximately borne out by some rough empirical work I have done.

DISCUSSION

GEORGE KUZNETS
University of California

I should like to begin by making two brief comments, the first of a specific and the second of a more general character on Glenn Johnson's ably conceived review of research in production economics. (1) In connection with fitting production functions to input-output data attention should be drawn to the possibility of estimating the required points on the production surface without specifying the parametric form of the relation. Clifford Hildreth has done interesting work along this line both in estimating the most profitable combination of inputs considering the available observations as sets of discrete alternatives in a linear programming framework, and also by imposing certain restrictions on the function, for example by requiring that the function be concave, but not otherwise specifying it (Clifford Hildreth, "Point Estimates of Ordinates of Concave Functions," *Journal of American Statistical Association*, September 1954). (2) The more general comment refers to Mr. Johnson's conclusion that "aggregative supply studies have been less satisfactory, both empirically and conceptually, than the micro production economic work." Professor Schultz's stricture delivered at last December's meetings seems much to the point here. He deplored "the drift towards even greater detail in examining of farms. Instead of working up and out from the firm (farm) to product and factors markets, what is happening increasingly is to go in and down into the detailed intricacies of the various crops and various livestock enterprises and into plant design, engineering, plant management, technical arrangements and relationships," (as reported in L. L. Boger, "Important Professional Problems Facing the Agricultural Economist," *Journal of Farm Economics*, May 1954, p. 307). This is an important matter which cannot (and should not) be settled in a sentence or two, nevertheless I venture to suggest that the accretion to agricultural economics of substantive knowledge and possibly of methodological know-how is not likely to be large from the proliferation of case studies of technical relations each carried out in a highly specialized setting.

It is good to know, as Mr. Foote tells us, that experience is being accumulated with multiequation models on practical problems (wherever such procedures seem appropriate) and particularly that further work is underway in the experimental testing of the behavior of various estimates obtained in small samples and under such complications as serial correlation. Still, of the four areas singled out in Mr. Foote's paper as those in which significant advances are being made I would be inclined to rate the utilization of data from consumer panels as holding the greatest promise of obtaining valid estimates of short-run consumer demand (purchase) parameters. At least some of the old problems that beset demand analysis based on time-series aggregates (and for which there are probably no good solutions possible in terms of techniques of analysis) appear to be of lesser importance when one deals with individual consumer panel data in which variation can be observed both over time and over consumer units. For panel data to be fully usable in the measurement of direct and cross elasticities of demand it is necessary to obtain supplementary data on prices confronting panel families for items not purchased and sufficient

information on panel family characteristics so that the effects on purchase behavior of these non-economic variables can be netted out. The working hypothesis is that the number of such family variables impinging importantly on purchase activity is not very large.

Panel data are, of course, still the results of passive observation of consumer purchase behavior. The paper by Dr. Brunk is concerned with experimental methods of measuring consumer responses to non-price variables by direct manipulation of the latter. The limitation to non-price variables is wisely taken for while it may be possible to measure experimentally something resembling price elasticity of demand facing a group of retail outlets it is virtually impossible to perform such measurements for markets of any size, for example a city. Dr. Brunk is a severe critic of his own pioneering efforts and I find myself in the somewhat unusual position of being obliged to defend him against some of the criticisms that he more or less accepts. One of the questions that concerns him is the determination of long-time effects of a merchandising practice. But by definition all *competitive* advantage is short-lived. In the dynamic world of scientific merchandising possibly the only certainty is that the gimmick of today will be matched by the gimmick of the not-too-distant tomorrow.

RECENT ECONOMETRIC STUDIES IN AGRICULTURAL MARKETING*

Chairman: Harry C. Trelogan, Agricultural Marketing Service, USDA

AN ECONOMETRIC MODEL OF THE WATERMELON MARKET

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I. *Introduction*

IN THIS paper we present a complete, empirically determined supply and demand structure for the watermelon market. In addition to presenting the final model, we shall apply the results to an analysis of some of the dynamic properties of the market. We will investigate its stability, the path of adjustment toward equilibrium, and the speed with which such adjustment would occur, other things being equal. Finally we will employ the model to forecast the watermelon market a year ahead. In the process of our discussion we will make a few remarks about technical problems encountered.

Although a large number of attempts—many of them eminently successful—have been made to determine empirical demand and supply schedules, the present work is one of the few in which both are fitted for the same market. In view of the fact that supply and demand schedules have long been a part of the standard equipment of economic analysis, the absence of complete empirical models of individual markets is remarkable. It is due, I think, primarily to what has been until recently a serious technical limitation. It is now generally recognized that the classical least squares procedure can be properly applied only in situations where a single dependent variable is to be "explained" by a set of independent variables whose values, if not exogenously fixed, are at least predetermined with respect to the dependent variable in question. That is, least squares estimates of the effect of crop on price can be calculated where the demand in the market adapts price —the dependent variable—to the volume of the crop, predetermined by planting, weather, insect pests, etc., and not directly influenced by current price. But least squares regressions cannot be used to determine the supply and demand structure of a market in which price and quantity marketed are jointly determined dependent variables.

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* Proceedings of a joint meeting of the American Farm Economic Association and the Econometric Society in Detroit, December 29, 1954.

† Particular thanks are due to three students in my course in Applied Economic Statistics in cooperation with whom the model was formulated and the basic calculations prepared in the spring of 1954: to Woodrow Creason and William McGrath for their heroic efforts in calculation, and to Thomas Klein who, in addition, originally pointed out the important role played by cotton in the watermelon supply, and for his helpful criticism of the manuscript. Thanks are also due to Susumu Koizumi of the Michigan Research Seminar in Quantitative Economics who calculated the moving equilibrium of the final system.

In the last several years, however, a number of advances in statistical method have broadened the scope of research possibilities to include the treatment of systems involving a number of jointly determined variables. In terms of adaptability and cost, the most useful of these is the technique of "limited information." It would be fruitless to attempt to explain the method within the confines of this paper. It can be found well described and illustrated elsewhere.[1] Suffice it to say that it constitutes the basic tool of this analysis of the watermelon market.

The model to which this technique is applied is aggregative both in the scope of coverage—it includes total U. S. production, average prices, etc.—and in the fact that it is limited to annual data. Clearly not every aspect of the watermelon market can be adequately treated in this way. The watermelon is produced under widely differing conditions even within its area of heaviest concentration. A complicated pattern of shipping costs and available marketing channels links the growers with their several markets. Moreover, the seasonal timing of supplies in different parts of the producing area, possible seasonality in demand, and the extreme sensitivity of the city markets to temporary weather conditions give the intra-year behavior of the market a "fine structure" exceedingly complex and difficult to capture. In an aggregative model this fine structure is, of course, washed out.

II. *The Model*

Our model of the watermelon market consists of three economically meaningful relationships; (1) a crop supply schedule, (2) a harvest supply schedule and (3) a demand schedule.

(1) The crop supply schedule relates the total crop available for commercial harvest to lagged price and cost factors. Since the crop is perishable, decisions to plant must be made in the absence of knowledge about current prices. Thus the crop supply schedule relates the current commercial crop to the average farm price of the previous season.

In the short run the most important cost involved in the production of watermelons (or any farm crop) is the lost opportunity to produce other things. The most important cost factor in the case of watermelons appears to be cotton, a serious competitor for farm space. This cost factor is included as the average cotton price per pound received by farmers the previous year. It is clear, however, that the price of cotton will not always enter into the cost of watermelon production the same way. In particular the program of cotton acreage allotments put into effect in 1934 and there-

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[1] Lawrence R. Klein, *A Textbook of Econometrics*, Row Peterson, 1953, esp. Chapt. III pp. 122–133 and Chapt. IV pp. 169–184. William Hood and Tjalling Koopmans, *Studies in Econometric Method*, John Wiley and Sons, 1953, especially Chapt. 6 pp. 162ff. Gerhard Tintner, *Econometrics*, John Wiley and Sons, 1952, pp. 172–184.

after presumably had some effect on the supply of watermelons. Some effort was devoted to attempts to quantify this program, but it was finally decided that it could best be represented by a dummy variable that had the values 0 before 1934 and 1 for 1934 and thereafter.

Although the production of watermelon is heavily concentrated in the South, it was felt that some more general costs should be included to cover more northern production. An index of the price of commercial truck crops was employed for this purpose, although as will be seen, this proves not to affect the supply significantly. This is probably due to the fact that a relatively small portion of total commercial truck crops actually compete with watermelons for farm space. A more satisfactory result could probably be obtained by constructing an index of such truck crops as are serious competition with watermelons for acreage, but this has not yet been done.

Finally, the supply of watermelons was seriously influenced by the war. The choice was either to omit the war years from the process of fitting the model, or to include some recognition of the effect of the wartime program. The latter alternative was adopted, a second dummy variable being employed to represent the presence of the war. This variable is entered with a lag and has the value 1 during the years 1943 through 1946 and 0 at all other times.

The general form of the crop supply is then:

$$(1') \qquad Q = aP_{-1} + bC_{-1} + cJ + dT_{-1} + eK + f$$

where Q is the commercial crop of watermelons available for harvest, P_{-1}, C_{-1} and T_{-1} are the prices of watermelons, cotton, and commercial truck, lagged one year; J and K are dummy variables representing government cotton policy and the war respectively. In the actual process of fitting the equations all except dummy variables were measured in logarithmic form. Thus the parameters of the actual variables are elasticities, while those of the dummy variables are readily translated into percentage shifts in the schedule. The crop supply equation is fitted to data for the entire period, 1919–1951.

(2) The harvest supply schedule is a relationship between quantity marketed, current farm price, harvesting cost, and the crop for harvest. The crop supply discussed above is, of course, merely the quantity of melons *available* for harvest. The harvest supply dealt with here is the quantity of melons actually harvested and marketed. Unlike the decision to plant, which must be made in absence of knowledge of current prices, the decision to harvest or leave the crop unharvested may be made in light of current price quotations as compared with the cost of harvesting. An index of southern farm wage rates was taken as the best approximation to some measure of harvesting cost. Because of the small number of years available for fitting the market supply schedule it was deemed advisable to save a

degree of freedom by including this variable in the ratio of the current farm price to the current farm wage rate.

In no event can the harvest of melons exceed the crop. Thus the harvest equation has the general form

$$(2'a) \qquad X = a' \frac{P}{W} + b'Q + c' \quad \text{or,}$$

$$(2'b) \qquad X = Q \quad \text{whichever is smaller.}$$

X is the number of watermelons harvested and W the southern farm wage rate. Information on the magnitude of X is not available before 1930 and the harvest supply is fitted in logarithmic form to data of the period 1930–1951.

(3) The final equation in the model is the demand. In order to make the demand equation fit readily with the two supply functions it was decided to measure demand at the farm level. The demand schedule then relates the current farm price of watermelons to current per capita disposable income and per capita market supply. Moreover, since this is a derived demand, it depends not only on market demand factors proper, but also on the cost of shipping from farm to market. As a measure of this, the function includes the current average cost of farm-to-market rail shipment of watermelons. This is admittedly a crude measure of actual shipping costs. A relatively small portion of all production moves to market by rail. (At present only a fourth to a fifth of all melons are shipped this way.) Moreover, this proportion has been steadily declining over time. Nevertheless the average farm to market rail freight cost must serve at least as an index of freight costs in the absence of any better measure. Where N is population, Y disposable income, and F freight cost, the demand equation has the general form

$$(3') \qquad P = a'' \frac{Y}{N} + b'' \frac{X}{N} + c''F + d''.$$

The farm demand equation is fitted in logarithmic form to data covering the period 1930–1951.

The resulting fitted equations are as follows (figures in parentheses are standard errors);

Crop supply:

$$(1) \qquad Q = \underset{(.156)}{.587P_{-1}} - \underset{(.095)}{.320C_{-1}} + \underset{(27.40)}{34.41J} - \underset{(.238)}{.141T_{-1}} - \underset{(45.17)}{155.97K} + 768.735.$$

Harvested Supply:

$$(2a) \qquad X = \underset{(.110)}{.237} \frac{P}{W} + \underset{(.114)}{1.205Q} - 118.041 \quad \text{or,}$$

(2b) $X = Q$, whichever is smaller.

Demand:

$$(3) \qquad P = \underset{(.088)}{1.530}\,\frac{Y}{N} - \underset{(.246)}{1.110}\,\frac{X}{N} - \underset{(.183)}{.682}F - 140.163.$$

It is clear from equation (1) that the price elasticity of crop supply is about .6, while the cross elasticity of crop supply with respect to the price of cotton is about −.3. The coefficient of the dummy variable J, presumably representing the influence of the cotton acreage allotment program, indicates an increase in watermelon supply of about ten per cent;[2] but as the sampling error shows, this is not significant.

Likewise the cross elasticity of supply with respect to the price of commercial truck, estimated at −.14, is not significant. On the other hand, wartime policy clearly reduced the supply of melons significantly, the size of the parameter corresponding to a reduction of 30 percent.[3]

In equation (2) the price elasticity of harvested supply, given the available crop, is about .2. As may be expected this is considerably lower than the elasticity of crop supply. The harvest increases with the available crop, and percentage wise apparently increases somewhat faster than the crop. Since the model involves averaging effects over a fairly wide region, there is no particular reason why this should not be so, but it may be noted that the coefficient associated with the available crop does not actually differ significantly from one.

The parameters of (3) are not readily interpreted as written. Dividing by the coefficient of X/N yields the more familiar form

$$(3^*) \qquad \frac{X}{N} = 1.378\,\frac{Y}{N} - .901P - .614F - 126.273$$

from which it is clear that the income elasticity of demand is about 1.4 and the price elasticity of demand about −.9. The effect on consumption of an increase in freight rate is, of course, similar to that of an increase in the farm price, since freight costs are a substantial part of the difference between farm price and market price. The magnitude of its influence arises from the fact that farm to market freight charges are, on the average, almost as large as the net farm price itself. Indeed the comparison of these two magnitudes provides a check on the reasonableness of the coefficient measuring the influence of freight costs. During the period (1930–1951) used to fit the de-

[2] As noted in the Appendix, the variables are coded. When dummy variable J takes on the value 1 after 1933, it results in adding 34.41 to the coded log of Q. This amounts to adding .03441 to the actual log of Q; i.e., Q itself is increased by about ten per cent. Similarly when K takes on the value 1 the result is the subtraction of .15597 from the log of Q. This has the effect of multiplying Q by a factor of .7; i.e., Q is reduced by thirty per cent.

[3] See note 2.

mand equation, the magnitude of the average freight cost was about seventy-seven percent of the magnitude of the average farm price. If it is expected that, market demand conditions given, an absolute increase in freight cost will be passed back to reduce the net farm demand price by about the same amount, the coefficient on F in equation (3) would be expected to be somewhere near −.77. The empirically determined parameter of −.68 in equation (3) is thus eminently reasonable.

III. *Technical Statistical Problems*

Although the emphasis here is on the final result and its applications, a few remarks about the statistical problems involved in fitting the model are in order.

No difficulty was encountered in fitting the crop supply equation. All

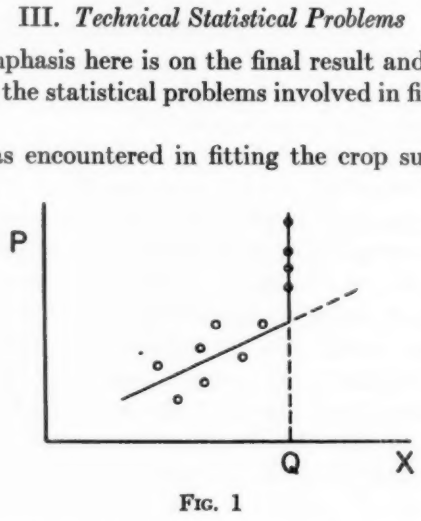


FIG. 1

variables on the right side of that equation are predetermined and the regular regression by least squares gives an unbiased estimation of the parameters. The harvest supply and farm demand, however, involve farm price and harvested crop as mutually determining variables, and the estimation of the parameters of these equations by least squares would lead to biased results. The technique of limited information was employed to obtain unbiased estimates of the parameters. For this purpose the variables Y, N, W, F, and Q were taken as predetermined with respect to the watermelon market. Now this is not strictly the case. While Q and N are predetermined without question, it is surely clear that what farmers receive for watermelons becomes in turn part of the national income; in addition, the price of melons, via its effect on the demand for farm labor, contributes to the determination of farm wages. It was felt, however, that the watermelon market exerted such a minor influence on these other magnitudes that the error involved in neglecting it would not be great.

A second sort of problem arose in connection with the harvest supply equation. The available crop sets a maximum to the amount that can be marketed. Thus the harvest supply schedule is not linear, but has a kink

at the price at which the entire crop would be harvested. This kinked supply might be handled by approximating its shape by a smooth curve. The more direct approach followed here is to fit relation (2a) by ignoring all years in which no unharvested crop is reported.

The problem is illustrated schematically in figure 1. X, the actual amount harvested, cannot exceed Q, the available crop. Thus the harvest supply schedule has an upper branch of zero elasticity and a lower branch along which market supply responds to price. In order to fit a regression to the lower branch only, we may drop out data for all those years that presumably appear on the upper branch—i.e. those years in which the entire crop was reported marketed. There were six such years: 1941–1945 and 1948.

IV. *Experimentation with the Form of the Model*

In addition to the construction of the model just given, a number of experiments were tried, of which the following two are of considerable interest.

A. Since the crop supply actually produced in any given year involves not only decisions to plant but also the results of weather conditions, insect pests and similar factors, it would appear that one might get a somewhat better measure of the crop supply function if acreage, rather than actual crop, were taken as the dependent variable. Some of the variation in crop produced by these external factors should be absent from acreage. The use of acreage gave the following interesting result. Where A is acreage,

$$(1^*) \quad A = \underset{(.175)}{.575P_{-1}} - \underset{(.107)}{.434C_{-1}} + \underset{(30.8)}{103.727J} - \underset{(.278)}{.150T_{-1}} - \underset{(50.6)}{180.744K} + 305.388.$$

A comparison of this result with that of (1) above shows that in neither magnitude nor standard error is there any significant difference between these two formulations of the crop supply, with the single exception of the parameter purporting to measure the effect of the governmental cotton program. This parameter, which was of no statistical significance in the first equation, is highly significant in the alternate form. If the supply of watermelons did not increase after 1934, the acreage planted certainly did with an indicated rise of roughly twenty-five per cent. It should be emphasized, however, that the indicated shift is not necessarily a direct consequence of the restriction of cotton production, but may be due in considerable part to extensification of watermelon production methods quite independent of the cotton program. This issue can only be resolved by detailed technical information as to cropping practices.

B. One shortcoming of the demand equation as formulated in (3) above is the fact that no prices of substitute commodities are included. In an

attempt to rectify this situation, cantaloup was taken as a substitute commodity on the grounds that the two commodities are alike and are frequently offered together as choices on the menus of restaurants, and since they have roughly the same seasonality the average annual prices are directly comparable. Since the demand equation was estimated by the method of limited information, this meant in effect introducing the supply of cantaloup implicitly as part of the model of the watermelon market. The calculations were carried far enough to indicate that the parameters that would be estimated were nonsensical (e.g., the price elasticity of watermelon demand appeared positive, while the income elasticity was negative!) and that they would be accompanied by very large standard errors. In other words, whatever the extent to which cantaloup and watermelons are substitutes, the effect is so small relative to the influence of other factors that they cannot be measured in so rough a model.

V. *Application of the Model—the Dynamics of the Market*

The watermelon market is essentially a dynamic one, the year to year behavior tending, as we shall show, to follow a cobweb pattern of oscillation.

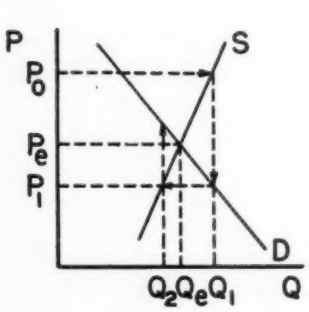


FIG. 2a

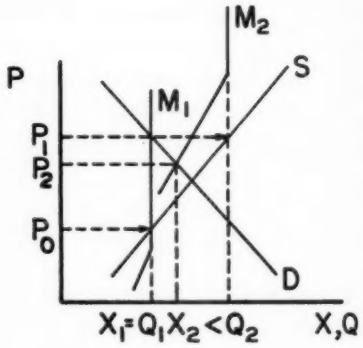


FIG. 2b

The theory of such oscillations is generally familiar, but because the model of the watermelon market contains the harvest supply function as an additional relation, it is worth while to describe the modifications required of the usual textbook model. Figure 2-a depicts the usual two equation dynamic cobweb model. Price P_0 results in production Q_1 the following year, accompanied by price P_1, and so on. The process may or may not converge to the equilibrium price and output defined by the intersection of the two schedules. In figure 2-b, a harvest supply schedule has been included, indicating that the amount supplied depends not only on production, Q, but also on *current* price. Unlike the demand and crop supply equations, the harvest supply function cannot be located as a simple relation between

price and quantity. Rather, each possible crop Q is associated with a different short run harvest supply schedule. Thus price P_1 determines production Q_1. This in turn determines the harvest supply schedule, say M_1. The harvest supply together with demand determines quantity marketed (in this case $X_1 = Q_1$) and price P_1. The new price determines a new crop, Q_2 and a new harvest schedule, say M_2, resulting in price P_2 and quantity marketed X_2.

The equilibrium price and quantity are readily identified in the case usually presented, but when the harvest supply is introduced the equilibrium might be either one in which the total crop is marketed (as in figure 3-a,) or one in which production exceeds marketings (as in figure 3-b). In the latter case, price P_e is just sufficient to call forth production Q_e. This in turn determines the harvest supply schedule M_e which in conjunction with demand sets price P_e and quantity marketed X_e.

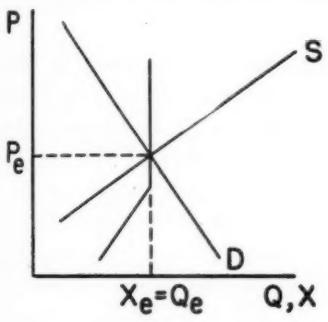


FIG. 3a

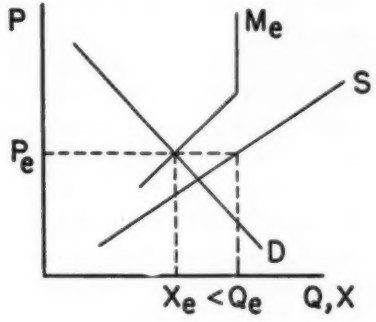


FIG. 3b

The fitted empirical model can be used to investigate a number of the properties of this dynamic process. In the first place we may determine whether the equilibrium is stable. Secondly the dynamic path of adjustment can be investigated to determine whether it is, in fact, a cobweb, or whether approach to equilibrium is one-sided. In the model as customarily presented, the oscillations necessarily take place *around* the equilibrium position. With the addition of the market supply equation it is quite possible to have a monotonic approach toward (or departure from) equilibrium. We may inquire into the speed with which the system tends to approach its equilibrium position, and incidentally determine whether the existence of the harvest supply schedule tends to increase or diminish the speed of adjustment. Finally we may study the equilibrium itself.

In order to explore the dynamic properties of the system we may substitute equations (1) and (2a) into (3), to obtain the difference equation

$$P + .622P_{-1} = H \tag{4a}$$

where H is a linear combination of the values of the remaining variables.

If the equilibrium of the market occurs at a position in which harvest supply is described by (2a) then the market equilibrium price P_e will also satisfy (4a):[4]

$$P_e + .622P_e = H. \tag{5a}$$

Now, still assuming equation (2a) to hold at the equilibrium we can subtract (5a) from (4a) to obtain a difference equation relating successive deviations of actual price from equilibrium price:

$$p + .622p_{-1} = 0, \tag{6a}$$

where $p = P - P_e$. Difference equation (6a) has the obvious solution

$$p = p_0(-.622)^t, \tag{7a}$$

where p_0 is the deviation of market price from equilibrium at some initial time $t = 0$.

The dynamical properties of the system may readily be deduced from (7a). Since the number in the parentheses is negative, p_t changes sign each period. Thus a price above equilibrium, other things being equal, is followed by one below, and the oscillations of price—even if the market supply has form (2a) at the equilibrium—follow a cobweb pattern around the equilibrium. Secondly, since $-.622$ is smaller than one in absolute value, deviations from equilibrium approach zero in the limit, and the equilibrium is in fact a stable one. Finally the speed of approach is readily determined. If we borrow a term from the physics of radioactive decay, we can ask how long the half life of the process is, i.e., how long it takes to reduce the magnitude of a given deviation from equilibrium by half its original absolute magnitude. Since $(-.6)^2 = .36$, clearly the half life of this process is less than two years. In fact, the "ninety percent life" is slightly less than five years, indicating a heavily damped oscillation with rapid approach to equilibrium.

Now let us suppose on the other hand that the equilibrium solution requires that the harvest supply equation have form (2b), i.e., at the equilibrium everything produced is marketed. In this case we repeat the above process, replacing (2a) by (2b) throughout. As a result the final difference equation becomes

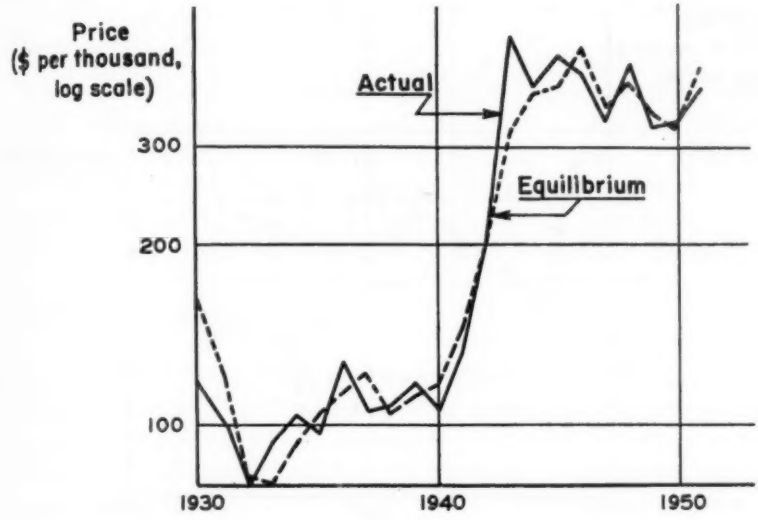
$$p_t = p_0(-.652)^t \tag{7b}$$

---

[4] At the market equilibrium either equation (2a) or (2b) must hold. Which one it is depends on the values taken by the other variables. Since we do not know in advance which it will be, we must investigate both possibilities. It is to be noted, incidentally, that there is no quesion here of the existance of the equilibrium, nor of the fact that it is unique. What is at issue is the question of its stability.

which possess almost identical properties with (7a), except that the adjustment toward equilibrium is somewhat slower, the ninety per cent life of (7b) being slightly longer than five years. To the extent that the additional freedom to adjust implied by the harvest supply function has any effect on the speed of adjustment in the market, the result is to increase it.

To calculate the moving equilibrium position of the model, that is the values that would ultimately result if the conditions of each year should persist indefinitely, we first solve the system (1), (2a) and (3) for its equilibrium values of P_e, Q_e and X_e. If X_e is less than or equal to Q_e, these are the



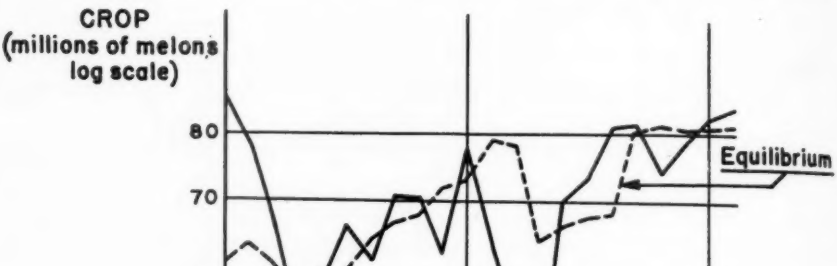
Watermelon Price: Actual and Moving Equilibrium, 1930–1951

FIG. 4

true equilibrium values. If X_e is larger than Q_e, (2b) is used in place of (2a) and the solution yields the equilibrium valves. The moving equilibrium values P_e and Q_e respectively are plotted together with the actual current values of P and Q in figures 4 and 5. In each case, as might be expected, actual price and quantity tend to oscillate around the moving equilibrium. It will be noted moreover that the market price tends to follow its equilibrium value more closely than does the crop. The reason is that any shift in supply or demand conditions, last year's price being given, tends to shift the equilibrium crop away from the actual crop. On the other hand, the same shifts in schedules that tend to alter the equilibrium price tend likewise to carry the current price with them. This can be seen especially clearly during the period immediately following 1940.

VI. *Application of the Model—Forecasting the Watermelon Market*

In principle there is no difficulty in applying the model to the task of forecasting the melon market. The required magnitudes are inserted and the system solved for the resulting values of crop, price and harvest. Unfortunately, however, the practical operation does not go smoothly. There is, in the first place, the obvious fact that price depends on values of per capita disposable income, wages, and freight costs which in the nature of things cannot be definitely known in advance. The statistical errors in the model proper will necessarily be coupled with the errors in forecasting these



Watermelon Crop: Actual and Moving Equilibrium 1930–1951

FIG. 5

other values. Secondly, even the data for the preceding year are frequently available only as preliminary estimates. The "actual" price figure for 1952 presented here is the preliminary estimate published in *Agricultural Statistics*, 1953; the "actual" prices for 1953 and 1954 are based on the behavior of the average prices for June, July, and August of those years. The prices used for cotton and truck crops are likewise crude.

Two separate sets of forecasts have been prepared. In the first set, the "ex post" forecasts, we have used the actual *ex post* values of income, wages, etc. The resulting forecasts are those that would have been obtained if the values of the other variables had been properly predicted. They represent the forecasting performance of the model itself. These values appear in Table I.

TABLE I. "EX POST" FORECASTS OF WATERMELON CROP AND PRICE

Year	Crop[a] (Millions of melons)		Price (Dollars per 1000)		Price Change (Dollars per 1000)	
	Forecast	Actual	Forecast	Actual	Forecast*	Actual
1951		88.3	—	$369	—	—
1952	77.5	81.7	$405	447	+36	+ 78
1953	90.3	n.a.	378	393[b]	−69	− 54[b]
1954	88.4	n.a.	387	280[b]	− 6	−113[b]

[a] Watermelon data have been revised, beginning in 1952. Crop estimates here are comparable to the old series.
[b] Based on the movement of unweighted averages of monthly prices for June, July, and August.
* Difference between forecast P and actual P_{-1}

Where the forecasts employ the more reliable lagged prices (i.e. the forecasts of 1952 and 1953) the comparison shows a fairly satisfactory performance of the model. The forecast of 1954, based on a crude estimate of 1953 price and compared with a crude estimate of 1954 price, shows the "proper" direction of change, but that is about all that could be claimed for it. Whether this really represents a bad forecasting error or derives primarily from the poor data remains to be seen when better data become available.

In Table II are the values forecast on what we have called an "ex ante" basis. That is, each of these forecasts was based on information about the variables that would have been available at the end of the year preceding the year to be forecast. For this purpose the values of wages and freight rates are predicted unchanged over their previous magnitudes, and population was forecast on the basis of its trend. The forecasts of personal disposable income were obtained from a fifteen equation model of the U. S. economy devised by Lawrence R. Klein and Arthur S. Goldberger.[5]

TABLE II. "EX ANTE" FORECASTS OF PRICES

Year	Price (Dollars per thousand)		Price Change (Dollars per thousand)	
	Forecast	Actual	Forecast*	Actual
1952	$415	$447	$+ 46	+ 78
1953	379	393[a]	− 68	− 54[a]
1954	403	280[a]	+ 10	−113[a]
1955	484	—	+204	—
(1955)	(396)[b]	—	(+116)[b]	—

[a] Based on average price June, July, August.
[b] Calculated from *ex post* forecast price, 1954.
* Forecast P less actual P_{-1}.

[5] Lawrence R. Klein and Arthur S. Goldberger, *An Econometric Model for the United States, 1929–1952*, to be published in the near future by North Holland Publishing Co., Amsterdam. The forecasts of personal disposable income were prepared for this paper by Mr. Goldberger.

The resulting price forecasts appear in Table II. The forecasts for 1954 and 1955 are, of course, based on the same crude price averages mentioned above and are open to serious question. The very high price forecast for 1955 derives primarily from the very low figure of $280 estimated as the average price for 1954. As an alternative method of estimation, the 1954 "actual" price was replaced by the *ex post* forecast for 1954. This estimate appears in parentheses in the table, and constitutes, I think, a somewhat better forecast of 1955 price than the one based on the crude average.

Finally, in principle it is possible to use this model at two levels of forecasting. A preliminary forecast can be prepared—as was done here—by using past prices to estimate the coming crop, and forecasting future prices on the basis of this estimate. During the spring when estimates of crop planted become available, a refined forecast could be made on the basis of directly estimated crop.

That this is not illustrated here is due to the fact that the recent revision of watermelon production and price estimates resulted in an increase in currently estimated annual crops of roughly twenty-five per cent. Thus the current crop reports are not comparable to the quantities estimated from equation (1). Price revisions, on the other hand, were of the relatively small order of two or three per cent. Prices from the two stage forecasting process employed here are therefore roughly comparable to the current series. Ultimately an entire new model will be required based upon the revised data.

Appendix

The data employed in measuring the variables were as follows:

Q: Total number of melons available for harvest. Source of data, *Agricultural Statistics, 1952*. Period employed, 1919–1951.

P: Average annual farm price of watermelons, dollars per thousand. Source same as Q. Period, 1918–1951.

C: Average annual net farm receipts per pound of cotton, source and period same as P.

T: Index of farm price of commercial truck. Source: 1918–1923, constructed from data on selected individual truck crops; 1924–1951, *Agricultural Statistics, 1952*.

J: Dummy variable representing the cotton acreage allotment program. Has values 0: 1919–1933, 1; 1934–1951.

K: Dummy variable representing the effect of the war. Has value: 1, 1943–1946; 0 at all other time.

X: Total number of melons harvested. Source: difference between Q and quantities reported unharvested in *Agricultural Statistics, 1952*. Period covered: 1930–1951.

W: Index of farm wage rates, South Atlantic States. Source: derived from cash wage rates of hired farm workers, composite wage rate per month, as summarized in the *Handbook of Labor Statistics, 1950;* extended on basis of wage rate data in *Agricultural Statistics, 1952*.

Y: Disposable income of the United States. Source: Department of Commerce, 1930–1951.

N: Population: U. S. Census Bureau estimates.

F: Index of average shipping cost per ton of watermelons shipped by class I steam railways. Source: computed from data on tonnage of watermelon freight originating and freight revenue received for watermelon shipment given in the Freight Commodity Statistics of the Interstate Commerce Commission.

All except dummy variables are measured in logarithmic form. In the process of fitting the equations the logarithms were coded to read as three-digit whole numbers without characteristics. Where the range of variation made this inconvenient the logarithms were coded to read as three-digit numbers without characteristics, or four-digit numbers with the characteristic one. Since the result of the coding is merely a shift in the decimal point of the coefficients of dummy variables and a change in the size of the constant term of the fitted equation, no effort was made to "decode" the resulting equations.

MANAGEMENT OF MEAT INVENTORIES

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*University of Chicago and North Carolina State College**

THIS paper deals primarily with the pronounced seasonality that characterizes storage operations of meat-packing firms. Our purpose is to explain how firms make inventory decisions in the face of seasonality and to examine the implications of these decisions for the aggregate seasonal storage of meat.

I. *Environment of Inventory Decisions*

The model of meat inventory decisions that will be presented stems directly from consideration of the conditions under which inventory accumulation takes place. We begin by looking briefly at these conditions.

Structure of Inventories

Data on cold storage holdings as presented in Table 1 indicate the importance of different forms in which meat is held and permit a distinction as to whether holdings are pipeline or seasonal.[1]

Pork accounts for by far the largest amount of inventories, both pipeline and seasonal. The crucial inventory seasonally is frozen pork. Although there is considerable variation in the relative importance of the different kinds of meat, the seasonal movements are similar in many respects. The minimum inventory of pork items occurs about the first of November, while the minimum for beef items is typically somewhat earlier. On the other hand, beef inventories reach their maximum more rapidly than pork inventories. Lamb, mutton and veal have seasonal patterns similar to beef.

Seasonal accumulation of inventories provides a substantial, but far from complete, cushion to variations in meat production. Figure 1 illustrates this point. It shows meat production from slaughter under federal inspection by months and, subtracting change in inventories, the implied consumption.[2] The average monthly deviation for total meat is 152.1 in the production series and 67.0 in the consumption series. According to this measure,

* We should like to express our appreciation to persons in the packing industry for factual information with regard to inventories, and for discussions of inventory decision-making; however, we alone are responsible for the contents of the paper.

[1] The minimum holding of meats occurs at the beginning of the marketing year, just before the increase in marketings that will bring lower prices and hence losses to holding meat. Table 1 is derived on the assumption that this minimum amount represents the pipeline component of inventories. All additional inventories are considered to be seasonal. Peak seasonal inventories are shown, together with the time at which the peak occurs.

[2] The identity is that consumption plus additions to inventory equals production. We call the derived series "implied consumption" because of the use of federally inspected instead of total slaughter and because of neglect of exports and imports. The source of the figures is U. S. Department of Agriculture, *Livestock Market News Statistics and Related Data, 1953*, Statistical Bulletin No. 143, June 1954, pp. 25–26 and p. 52.

TABLE 1. COLD STORAGE HOLDINGS OF MEATS, 1952–53 MARKETING YEAR
(Millions of Pounds, First of Month)[1]

	Minimum Holdings (*Pipeline Inventories*)		Maximum Holdings		Difference (*Seasonal Inventories*)
	Month (1)	Amount (2)	Month (3)	Amount (4)	(4) − (2)
Total Meat	November	556.8	March	1,043.5	486.7
Pork	November	234.9	March	604.8	369.9
Frozen Pork	November	106.1	March	396.9	290.8
Other Pork	November	128.8	March	207.9	79.1
Beef	September	156.8	February	263.9	107.1
Frozen Beef	September	148.2	February	249.7	101.5
Other Beef	October	8.2	February	14.2	6.0
Frozen Veal	August	10.1	January	24.2	14.1
Frozen Lamb	September	11.3	March	23.7	12.4
Miscellaneous	November	50.6	February	69.8	19.2

[1] Source: U. S. Department of Agriculture, *Livestock Market News Statistics and Related Data, 1953*, Statistical Bulletin No. 143, June 1954, pp. 25–26.

storage eliminates over a half of the production variations. For pork, the average deviation is 137.2 in production and 72.6 in consumption.[2]

Data extending back to 1920 reveal some interesting historical changes

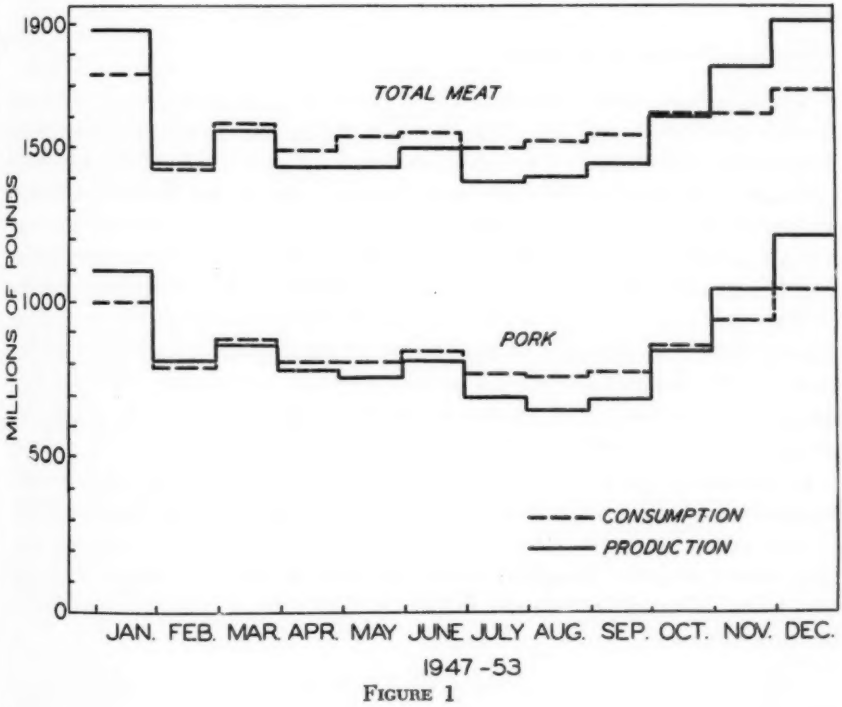

FIGURE 1

[2] Average deviations given in millions of pounds.

in various components of inventory. Technological considerations are undoubtedly relevant to the changes. An increase has occurred in minimum holdings of frozen pork, for instance, associated with larger holdings of frozen hams awaiting cure, with a concommitant reduction in holdings of cured meats. This particular set of changes has resulted from introduction of the so-called "pumping" process in curing meats (whereby the curing fluid is pumped under pressure through the blood vessel of the animal). An example of another change is a secular decline in the level of dry salt pork inventories, apparently reflecting declining consumption as influenced in part at least by improvements in transportation affecting marketing and also increases in refrigeration. A current development that may give more importance to non-pork inventory items in the future is the quick freezing of meats. Quick freezing is increasing rapidly, and many persons feel it is likely to continue to increase. If so, the magnitude of inventories may be expected to increase generally.

We will not pursue these technological kinds of considerations further in this paper. They are relevant primarily to pipeline inventories, whereas our interest lies in seasonal holdings. From this point onward we shall consider only seasonal holdings. For this reason attention narrows largely to pork, most particularly to frozen pork.

Inventory Problem of the Firm

There is trade among meat packing firms in most of the components of inventory. The market for these items is referred to as the green market.[4] Apparently about a dozen major brokers buy and sell in this market in Chicago; and, dealing through these brokers, individual firms can if they wish maintain anonymity in transactions. The existence of this market suggests a separation of economic functions, perhaps mainly between meat packing proper and later stages of marketing. More important for the present subject, however, is the separation implied between these and the storage function. Because of the option of buying or selling meat at this stage of the productive process, a firm need not necessarily tie its storage decisions to its production or marketing decisions, and it can be guided instead by the profitability of the storage function itself.

In analyzing the profitability of the storage function, two time periods suggest themselves. The firm accumulates inventories during the period of most plentiful supply (the *first* period) for sale during the rest of the year (the *second* period). Roughly, as can be seen in Table 1, the first period comprises November through February and the second period March through October.

[4] A distinction is made between the terms "green" and "fresh"; the former refers to uncured meat which is destined for later cure, such as frozen hams.

During the early portion of the first period fairly routine rules of inventory accumulation might indeed be followed. In January or early February, however, the firm finds itself in the following situation: It knows the present price of the meat that it is putting into storage and the cost of storage, but it does not know what prices are going to be when inventories will be liquidated in the second period. At this time (near the end of the first period) the extent of seasonal inventory accumulation must be decided. From past experience in marketing meat, and from an analysis of present conditions, the firm can reasonably be expected to know the average length of time the inventories it accumulates in the first period will be held, and to have an idea of the probability distribution of the average price at which these inventories may be sold. The chances can be estimated that the inventories being accumulated will sell at any particular price, on the average, in the second period. Since it knows the present price of meat, storage costs, and the average time inventories are held, the firm can compute the average unit cost of storing meat for sale in the second period; and, comparing this cost figure with the probability of the various average prices at which the inventory might be liquidated, it can find the probability distribution of profit from any given level of storage.[5]

Factors Affecting Profitability

Consider the costs arising from the decision to hold inventories seasonally. One part of the cost is payment for storage. The magnitude of this payment is suggested in Table 2, which reproduces a portion of the schedule of charges of a packer-owned public warehouse. Since the meat will be received fresh, the table indicates an in-out charge in the neighborhood of fifty cents per hundred pounds. If we assume that the inventory will be held for about six months and add storage charge per month for this length of time, we arrive at a total payment for storage in the vicinity of two cents per pound.

An additional cost is interest. If we assume interest charges of two percent per year, this might amount to something like one-half cent per pound for six months in view of the absolute level of meat prices, i.e. assuming meat prices somewhere near fifty cents per pound. Further cost arises in the form of shrinkage. Some shrinkage occurs at the time of freezing and some during the holding period. If we suppose the total to be about one percent, we arrive at a shrinkage cost of one-half cent.

Another cost is the discount due to freezing. Frozen pork loins ordinarily sell at a discount with respect to fresh loins. After being in storage about six months they acquire a "woody" flavor, which entails such a drastic

[5] We assume the firm will never plan to carry more than pipeline inventories into the new marketing year and therefore the inventory decision does not need to take account of events other than in the two time periods to which we have referred.

TABLE 2. CHARGES FOR MEAT STORAGE IN PACKER-OWNED PUBLIC WAREHOUSES

Item	Unit Charge Per	Handling In and Out Received		Storage Per Month
		Fresh	Frozen	
MEAT-Freezer				
Boxes—Bundles	Cwt.	$.37	$.19	$.15
Barrels	Cwt.	.39	.22	.18
Loose Hams	Cwt.	.48	.30	.17
Loose Bellies	Cwt.	.55	.37	.17
Loose Picnics	Cwt.	.58	.40	.17
Carcass Beef	Cwt.	.54	.36	.21
Carcass and Sides—Veal, Lamb, Pigs	Cwt.	.50	.32	.25
Beef Cuts—Loose	Cwt.	.48	.30	.21
Racks, Saddles, Quarters—Veal, Lamb	Cwt.	.53	.35	.22
Bones—Shank				
Box	Cwt.	.42	.24	.15
Bbl.	Cwt.	.42	.24	.20
Loose	Cwt.	.48	.30	.25
Bones—Soft				
Box	Cwt.	.48	.30	.25
Bbl.	Cwt.	.60	.42	.35
Loose	Cwt.	.66	.48	.40
Inspections—Boxes, etc.	Pkg.	.12	Minimum	1.25
Inspections—Bbls.	Pkg.	.42		

discount as to preclude entirely their being profitably held for this length of time. Within the six-month period, the discount is apparently not more than five percent, or about two and one-half cents.

The total of the costs that have been enumerated is eleven percent, or five and one-half cents per pound at the assumed price of meat. Some possible costs are not included in this estimate. We have not taken account of possible costs that may be incurred by the firm in getting meat to and from storage; nor have we included possible costs of rotation. Frozen loins, for instance, must obviously be replaced if storage is for more than six months.[6] Still additional considerations relate to the possibility of rising marginal costs, particularly as the point is reached where regular storage facilities become fully utilized. The firm may then have to ship to out-of-the-way places or resort to inferior facilities; the lack of any additional suitable facilities whatsoever would make marginal costs rise abruptly. One might argue that the recurrence of yearly shortages of storage space implied in this argument would result in the construction of additional facilities. Since these would be used only in peak storage periods, however, the return might not be great enough to cover costs. The storage charges included in our cost estimate undoubtedly reflect only average costs at usual levels of utilization of facilities. Obviously a great deal of study would be required

[6] The costs of replacement include an additional in-out charge plus the discount taken on the meat that is replaced.

to estimate the importance, if any, of the additional cost considerations that have been noted.

The gain to be balanced against storage costs in determining profitability is simply the seasonal change in price. Unlike costs, the price change that will take place is not known at the time when the firm makes its seasonal inventory decision. The average seasonal change in price of pork over the years appears to be between twenty-five and thirty percent; but in any one year, of course, the change may deviate considerably from such an amount. Figure 2 illustrates the situation with respect to 8 to 12 pound pork loins. The figure shows the ogive of seasonal percentage price increase for 1921–53, excluding the price control years 1942–46.[7] Twelve of the twenty-nine cases cluster fairly evenly between twenty percent and forty percent, while the others spread out above and below this range. This figure, based on historical evidence, gives some idea of the probability distribution of price change faced by the firm.[8]

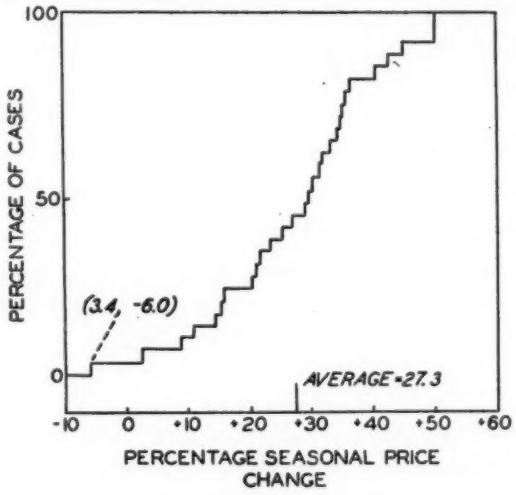

FIGURE 2

[7] Seasonal price increase is taken as the change from January price to the average of prices May through August. It seems better to us to use the actual, discrete, distribution of price changes as an estimate of the probability distribution facing the firm than to assume a normal distribution. The tail of the distribution is crucial to our subsequent analysis and the tail is greatly affected by smooth curve approximations. Figure 2 is derived from U. S. Department of Agriculture, *Livestock Market News Statistics and Related Data, 1953*, Statistical Bulletin No. 143, June 1954, p. 45 and *Livestock, Meats, and Wool Market Statistics and Related Data 1943*, p. 72.

[8] The reader may argue that in any particular year firms will be able to improve the estimate of the seasonal price rise in light of current conditions and that hence Figure 2 overstates the amount of dispersion in the probability distribution. We have tried regressions based on information available in January about disposable income and hogs on farms, and we have had little success. We are thus driven back to the historical distribution of price rises as a good approximation to information available about what the future may hold.

Risk

The decision to hold seasonal inventories is a speculative one, both in the sense that the gain arises purely from price change and also in the sense that the gain is by no means certain.

The financing of inventory accumulation is thus a matter of special concern to firms. We are told that an attempt may be made in the summer by some firms to accumulate a quantity of marketable securities that can be sold as funds are required for inventory, but that the major portion of seasonal storage is financed through borrowing. Loans from banks apparently provide the primary means by which packers finance their inventory, although a considerable quantity of commercial paper is also issued. Credit standing would be impaired if loans to finance inventory accumulation were not liquidated within six months, and banks might restrict credit to a firm altogether if it had failed to retire previous loans for inventory within six months.

Beyond mere impairment of credit, firms may clearly go bankrupt if their inventory holdings are too large in a year when the seasonal price rise falls drastically short of average. We are not surprised that formulation of inventory policy is one of the major responsibilities of top management in meatpacking firms.

II. *Inventory Decision-Making*

Our attempt thus far has been to characterize briefly the conditions under which seasonal inventory accumulation takes place. In light of these conditions we wish to suggest and comment on a model of the decision process by which the amount of accumulation is determined.

The Model

Our view is that the future liquidation price of inventories is the central variable both motivating storage through the hope of profit and simultaneously limiting the commitment to storage operations through fear of financial loss. We hypothesize that the firm attempts to maximize expected profits from seasonal storage, subject to a risk restraint. This risk restraint, which is the most unique feature of our model, is as follows: The firm will take no action that, with probability greater than some small amount α, would result in a loss exceeding some critical loss π^*.

To illustrate, let us visualize a firm's actions in the face of the conditions outlined in the first part of the paper. The average or expected rise in price is, at present prices, about thirteen and one-half cents per pound, as compared with the estimated storage cost per pound of five and one-half cents. The firm will clearly add to expected profit by accumulating meat, by eight cents per pound of accumulation. The question that immediately

arises is: What limits the amount of accumulation under these circumstances? One thinks first of an answer in terms of increasing marginal costs of storage. One might postulate that our cost estimate is simply inappropriate and that eventually the costs of adding to inventories will rise to a point where costs are equal to the expected change in price (i.e., thirteen and one-half cents), inventory accumulation being halted when this point is reached. Our model, while it allows for this solution, is of interest because it shows how the extent of inventory accumulations might instead be determined by risk considerations.

Let us suppose that the firm can add to inventories at a cost of only five and one-half cents per pound. Although the desirability of expected profits motivates an indefinitely large amount of inventories, the firm will contemplate larger and larger inventories with increasing concern; for a very great loss might be suffered should the expected price fail to materialize.

One might be inclined to conjecture that the critical loss on inventories, π^*, is the loss that would mean bankruptcy. There are at least two reasons, however, to suppose π^* is probably not as great as this. First, the price outcome that would bring losses on inventories would be likely to bring losses on other activities; bankruptcy would most likely occur, therefore, when the loss on inventories alone was less than the bankruptcy level. Second, the functioning of the firm might be seriously impaired by inventory losses even though bankruptcy did not occur. Possible damage to credit position, as mentioned earlier, is undoubtedly a major consideration. These reasons at least suggest the kind of conditions that determine π^*. Perhaps the most important point is that it will depend primarily on objective facts relating to the financial position of the firm.

The probability α on the other hand, being a reflection of aversion to risk, expresses subjective considerations. People who are willing to take big risks will let the probability of losses greater than π^* be large. One might be tempted to think that the extremely conservative firm would make α equal to zero. We suppose that typically it cannot make α zero, however, since this implies the possibility of a completely riskless existence.

Data are not available to apply the model to an individual firm; but estimates pertaining to aggregates can be obtained by referring to the data presented earlier. Suppose that each firm engaging in seasonal inventory accumulation is willing to take not more than one chance in a hundred of exceeding its critical loss (i.e., $\alpha = .01$). If we take the ogive in Figure 2 as an approximation to the "true" cumulative probability distribution and if we accept the estimate of storage cost of eleven percent, we can find a *critical loss per pound of meat stored* that taken with the *critical total loss* π^* determines the amount of inventories. The steps are as follows: The ogive indicates that a seasonal price fall as great as six percent will occur with probability .01. Subtracting cost we find that this event would mean a

loss of 17 percent on each pound of meat. The probability is .01 of a loss per pound greater than 17 percent. This is the critical loss per pound, which under the assumed price conditions would be 8.5 cents per pound. If we now introduce the assumption that the sum of the critical total losses for all firms undertaking storage is 42.5 million dollars, we find that risk will place a limit of 500 million pounds on seasonal inventory accumulation (42.5 million dollars divided by .085 dollars per pound). Any amount of storage larger than this would make the probability greater than .01 of losses exceeding 42.5 million dollars.[9]

Since actual seasonal accumulation is in the neighborhood of 500 million pounds, the above application of the model yields an estimate of π^* (i.e. π^* was chosen so that the amount of storage would be equal to observed seasonal accumulation). The estimate of 42.5 million dollars compares with total earnings for 1953 of 90 million dollars in the meat-packing industry as reported by the American Meat Institute. Although the comparison is admittedly crude, the implied conclusion is that for the packing industry as a whole the disaster level of loss on inventories is equal to about one-half of prospective earnings. This conclusion does not seem unreasonable, and the fact that the model can be applied in this way is suggestive of its relevance.[10]

Evaluation of the Model

Perhaps the main characteristic of the model to be emphasized is that the model purposely attempts to epitomize only the most important features of the decision process. Many features are obviously omitted. The model does not deal with uncertainty of accumulation price, with desire to satisfy regular customers with branded products at all times of the year, with "pipeline swelling" or involuntary accumulation of inventory, with rotation of stocks and other possibly important aspects of the storage operation. Some of these problems could be handled by the construction of a multiperiod model along lines similar to the one here discussed. Any further attempt to make the model more realistic in this sense would add considerably to its formal complexity, whereas we believe the relatively simple model presented here suffices to explain the main determinants of inventory accumulation.

A meaningful evaluation would seem to lie in considering two questions: (1) Supposing that risk is crucial to inventory decision-making, does our model give an adequate representation of reaction to risk? (2) May not an

[9] Because of the use of a discrete rather than continuous probability distribution, all α less than .034 will give the same result.

[10] The fact that our estimate of π^* is lower than total profits seems reasonable in view of the fact that storage is undoubtedly not spread evenly over the industry and, as noted earlier, credit rather than actual bankruptcy considerations may be paramount in limiting storage.

adequate representation of inventory accumulation lie in quite different directions from risk?

In regard to the first question, since the main activity of meat-packing firms is not inventory accumulation, it seems reasonable that they will attach great importance to avoiding disaster, or critical loss, from this particularly speculative activity. We feel that reaction to risk in terms of the one outcome π^*, rather than the whole probability distribution of outcomes, accurately reflects motivation. We do not go to the extreme of making avoidance of risk the only motivation; risk enters merely as a restraint to the maximization of expected profit. A possible shortcoming is that the model provides no explanation of how inventory accumulation fits into the overall pattern of activities as they may be influenced by risk. The model does not explain, for instance, the extent to which risk in other activities may limit inventory accumulation and vice versa; but it is entirely compatible with the existence of such limitations. The firm's position and plans with respect to other activities would be reflected in its choice of π^* and α. The handling of risk in this way seems particularly appropriate to the conditions under which meat inventory accumulation takes place. As with the complications noted previously, the very power of the model lies in excluding other cases.

Let us proceed to the second question, namely the possibility of explaining inventory decisions without reference to risk. One alternative explanation might be in terms of rules-of-thumb, or routine procedure. This explanation may indeed appear valid in particular situations. It is not inconsistent with our model, since the purpose of the rules-of-thumb may be to approximate our risk restraint.[11] Another explanation we reject is that inventories are accumulated in order for the firm to "supply customers." The implication is that, at least seasonally, there are market imperfections such that supply and demand are not equated by price. The existence of the green market would seem to be strong evidence against this view. This market indicates a ready future source of supply, making the problem one of uncertainty as to price rather than quantity, as we have in fact postulated. Still another explanation might be in terms of a more usually mentioned imperfection, namely, monopolistic restriction, although this usually has not been included in analyses of seasonal markets. Monopolistic maximization of profits from seasonal storage, more than simply assuming that the firm takes account of the effect of its own actions on price, assumes that the firm takes account of the difference in price change as between withholding (adding) a given amount to supply in one season and adding (withholding) this same amount in another. We feel that such behavior

[11] Our model might be useful as a managerial device in allowing each year a closer approximation to the desired position than more routine procedures.

requires more reliable knowledge, particularly about the second derivative of the demand curve, than firms can reasonably be supposed to possess.

Finally, consider the possibility that the main explanation is in terms of costs, namely, that rising marginal costs of storage are equated to expected price change. If this explanation were valid, the implication clearly would be that we have underestimated costs, in view of the amount by which the usual seasonal price rise exceeds our estimate. Our cost estimate would have to be increased about two and a half times in order for this explanation to suffice. We cannot find any possible errors that would lead to a divergence

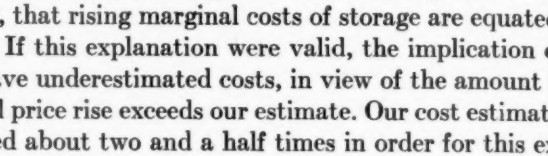

FIGURE 3

of this magnitude; even a doubling of the estimate would certainly be much more than ample to allow for the unmeasured cost terms mentioned in the first part of the paper.

Aggregate Seasonal Accumulation

An important question suggested by the above model is whether or not, in view of risk, there is a desirable seasonal distribution of meat consumption. A usual view is that maximum social gain occurs when the amount of storage makes the difference in price between the two periods equal to storage cost.

Consider first the negatively sloped schedule in Figure 3. This schedule illustrates how the average seasonal change in price may vary with the amount of seasonal inventory accumulation. Its shape depends both on the demand for meat and on average seasonal variations in production; thus it will strike the y-axis at the proportionate price rise that would occur in the absence of any seasonal storage and will strike the x-axis at an amount of storage that would entirely eliminate seasonal price fluctuations.[12]

[12] Figure 3 assumes that 900 million pounds of seasonal accumulation would eliminate seasonal price fluctuations. This estimate is based simply on the amount that would be needed to provide a stable flow of consumption. We have no ready source of information on seasonal shifts in the demand schedule for meat. For purposes of the present analysis we assume such shifts to be of minor importance.

The other schedule in Figure 3 is intended to approximate the amount of storage that firms would undertake in response to differing average seasonal changes in price.[13]

The important features of this curve are as follows: Firms will undertake no storage as long as the average increase in price is less than storage costs, for expected profit will motivate none. The schedule is perfectly flat at an average increase in price equal to the cost of storage, so long as storage multiplied by the critical loss per unit at that average increase in price is less than π^*. With increases in average price above the cost of storage the critical loss per unit decreases and hence permits larger amounts of storage for the given π^*. An asymptote is reached at the average increase in price corresponding to a zero critical loss per unit. When the probability of no loss per unit becomes equal to α, risk ceases to limit storage.[14]

The intersection of the two schedules, the one depicting what the actual average price change would be for different amounts of storage and the other depicting storage response of firms to average price change, illustrates the determination of storage and the average increase in price implied by our model.[15]

We see that cost plays a part but that, as conjectured earlier, risk does in fact limit accumulation. If α were large enough and/or π^* large enough, the perfectly elastic segment would extend far enough to make risk irrelevant. The average seasonal price rise would then equal storage cost. If we have estimated cost correctly, however, π^* and α must be such that the perfectly elastic segment ends to the left of actual seasonal accumulation. Our conclusion that risk limits accumulation does not depend on the particular numerical example chosen. Rather, it depends on estimated storage cost in relation to actual average seasonal price rise. π^*, α, and the probabil-

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[13] It is derived utilizing the same assumptions as in the illustration of our model (that is, $\pi^*=42.5$ million dollars and $\alpha<.034$). The supposition also is that the shape of the probability distribution of price change as depicted in Figure 2 would be invariant with differing average price change.

[14] With expected increase in price greater than storage cost, seasonal accumulation is

$$\frac{\pi^*}{\{c-(p-K_\alpha)\}(.50)}$$

where c is cost of storage as proportion of meat price, p is proportionate price change, and K_α is the difference between p and the price change that will be exceeded with probability α. The assumed absolute price of meat is $.50. In the example $\pi^*=42.5$ million dollars, $c=.11$, and $K_\alpha=.333$. As can be seen the asymptote occurs when $p=.443$.

[15] Let us emphasize that we do not attempt to explain yearly variations. We have taken the extent of yearly variation in price rise as an important condition in our model but have not gone into the reasons for this variation. The data similarly reveal year to year variability in the amount of storage. This variability, while not explained by our model, is not inconsistent with it. Changes in expectations would change the amount of storage (this does, however, imply shifts in the probability distribution as depicted in Figure 2). Another reason might be routine procedures, as referred to earlier; the routine (such as, say, storing some constant proportion of production) could approximate the risk restraint on the average, while resulting in substantial changes in the amount of storage from year to year.

ity distribution could vary over wide ranges.[16] We do not in fact need our precise model of reaction to risk.

The difference between average price rise and storage cost might be viewed as a risk premium. If our cost estimate is correct, this risk premium is larger than the storage cost. Taking account of the shape of the negatively sloping schedule we also have an estimate of the amount by which storage is curtailed. If cost alone determined storage, there would be no curved segment to the schedule depicting firms' reactions; instead, the perfectly flat segment would be extended. This would intersect the negatively sloping schedule at an amount of storage about 200 million pounds more than under present circumstances, and that amount is what we would expect if cost were the major determinant.

Our conclusion suggests a paradox, namely as to why ways have not been found for "spreading" risks and thus eliminating or at least reducing the difference between average price rise and storage cost. The possibility of futures contracts as a means of facilitating spreading comes immediately to mind. Competition from firms or individuals not engaged in seasonal storage would be another way.

Appendix

In this appendix we first present the theory of inventory decision-making discussed in the text. Then we compare our approach with alternative approaches that might have been followed.

Notation and Assumptions. The variables are as follows:

p = price received per unit sold.
q = number of units stored.
$p_0(q)$ = price per unit in first period.
$k(q)$ = in-out cost per unit.
$c(q)$ = carry-over cost per unit.
π = profit from storage operations.

It is assumed that there is a known probability distribution,

$$f(p; q).$$

By definition,

$$\pi = q(p - C(q)),$$

where

$$C(q) = p_0(q) + k(q) + c(q).$$

[16] Different firms, of course, might have different α's, again affecting the shape of the curve but not the conclusion.

Maximization of Expected Profits. Taking expectation of profit and setting the derivative equal to zero, we find that the condition for maximum expected profit is

$$Ep = C(q) + q\frac{dC(q)}{dq} - q\frac{dEp}{dq}.$$

Some special cases will be of interest. If the distribution of prices is independent of quantity stored, or less restrictively if the expected price is not a function of quantity stored, the term involving dEp/dq of course disappears. If price in the first period, in-out cost, and carry-over costs are independent of quantity stored, the term involving $dC(q)/dq$ disappears. If neither expected price nor cost depends on quantity stored we have $Ep = p_0 + k + c = C$, where both Ep and C are constant and independent of the firm's storage policy. Either $Ep \leqq C$, in which case any positive storage would lead to zero or negative expected profit, or $Ep > C$ and expected profit increases monotonely with quantity stored. In the latter event maximization of expected profit would lead to infinite storage.

Restriction of Maximum Loss, or Assurance of a Minimum Degree of Safety. As the amount stored increases, a given deficiency between the price actually realized in the second period and the expected price becomes an increasingly serious threat to the financial position of the firm. We assume for this reason there is a minimum profit, π^* (most often considered to be negative, that is, a loss), below which management would be willing to have profits fall only a small proportion of times; say with probability α.[17] Given the distribution of prices, this may set an upper limit to the amount of storage the firm will be willing to carry. A q^*, or maximum storage, is to be determined such that, with probability of at least $1-\alpha$, profits will exceed a certain minimum π^*.

Since

$$p = \frac{\pi}{q} + C(q)$$

and

$$dp = \frac{1}{q}d\pi,$$

the distribution of profit, $g(\pi)$, may be written

$$g(\pi) = \frac{1}{q}f(p; q),$$

where in $f(p; q)$ the expression in π is substituted for the variable p. We then have

[17] In the text we changed the sign of π^* for convenience of exposition.

$$\Pr(\pi \leqq \pi^*) = \int_{-\infty}^{\pi^*} \frac{1}{q} f(p; q)d\pi \leqq \alpha.$$

The solution of this equation for q is q^*.

We need not necessarily work with the distribution of π, however. Given π^*, we might select a $p^*(q)$ such that

$$\Pr\{p \leqq p^*(q)\} = \int_{-\infty}^{p^*(q)} f(p; q)dp \leqq \alpha$$

where

$$p^*(q) = \frac{\pi^*}{q} + C(q).$$

The solution of this latter equation for q is likewise q^*.

In the special case referred to above where the costs of storage and the distribution of price are both independent of the quantity stored, we have

$$q^* = \frac{\pi^*}{p^* - C}.$$

If both numerator and denominator are negative (the relevant conditions in our opinion), this expression merely states that q^* is to be so chosen that when it is multiplied by the unit loss that will be exceeded with probability α, the resulting magnitude is the critical loss that must not be exceeded with probability greater than α.[18]

Two Illustrations. Suppose that price in the second period is rectangularly distributed and C is a constant, both price and costs independent of quantity stored. The distribution of prices is

$$f(p) = \left\{ \begin{array}{ll} \dfrac{1}{\gamma - \beta} & \text{when } \beta \leqq p \leqq \gamma \\ 0 & \text{elsewhere} \end{array} \right\},$$

and

$$Ep = \tfrac{1}{2}(\gamma + \beta).$$

Then expected profit

$$E\pi = q\{\tfrac{1}{2}(\gamma + \beta) - C\},$$

---

[18] When both numerator and denominator are positive, then q^* becomes a minimum storage to ensure the critical profit being exceeded with probability $1-\alpha$; in this case our safety considerations set no limit on storage. If numerator is positive and denominator negative, then safety considerations prevent storage, and if numerator is negative and denominator positive, considerations of safety set no limit on storage. We assume, unless otherwise stated, that both numerator and denominator are negative.

will be positive provided $Ep > C$, in which case expected profit increases proportionally with the amount stored. If $\beta > C$ the indication is for the firm to store an indefinitely large amount (as the firm began to store very large amounts the assumption that C and f(p) are independent of quantity stored would fail to continue to be a satisfactory characterization of reality). Suppose that $Ep > C > \beta$. Then the expected profit increases with storage, but so also does the loss in case price in the second period is in the interval β to C. In Figure 4 the expected profit $E\pi$, minimum profit $\underline{\pi}$, and maximum profit $\bar{\pi}$ are shown as functions of quantity stored. Because of the uniform distribution of price, any profit between $\underline{\pi}$ and $\bar{\pi}$ is equally

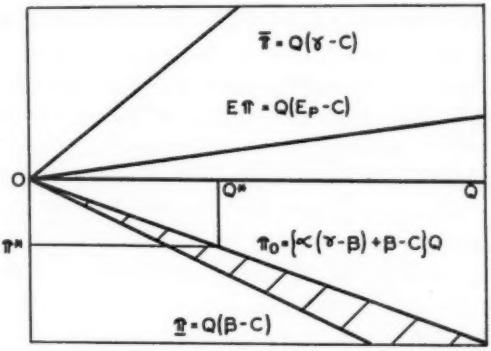

FIGURE 4

likely for given q. Suppose the firm considers it can disregard the chance things will actually occur that have probability of less than α. Then it will disregard the possibility of the shaded outcomes below the line π_0. Now suppose further the firm feels that it cannot risk losses on its inventory of more than π^*. Then the optimum storage is q* determined by the intersection of π_0 and a horizontal line at level π^*. Algebraically, the result can be obtained by evaluating

$$\Pr(\pi \leqq \pi^*) = \int_{q(\beta - C)}^{\pi^*} \frac{1}{q(\gamma - \beta)} d\pi = \alpha,$$

and solving for q to obtain

$$q^* = \frac{\pi^*}{\{\alpha(\gamma - \beta) + \beta\} - C}.$$

As a second illustration, consider the case where both second-period price and storage costs depend upon quantity stored, and the price distribution is normal. If both mean and variance depend upon q, we have

$$f(p; q) = \frac{1}{\sigma(q)\sqrt{2\pi}} e^{-[p-\mu(q)]^2/2\sigma^2(q)}.$$

Let t_α be defined

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{t_\alpha} e^{-(t^2/2)}\, dt = \alpha.$$

Then q^* is obtained by solution for q of the equation

$$\frac{1}{\sigma(q)} \left\{ \frac{\pi^*}{q} + C(q) - \mu(q) \right\} - t_\alpha = 0.$$

A Critique. The model elaborated here is obviously quite different from those figuring in recent contributions to inventory theory. The differences are of several kinds. In our model, present actions are relevant to only one future time period rather than many, and we gain much simplification as a result. Similarly, our "loss function" is not conceptually a complicated one, being equal to the negative of profits as determined by price change and storage cost. By assuming known probability distributions, we avoid non-probability approaches to uncertainty.

A theoretically distinctive characteristic is the decision criterion implied by the model. We have presented what A. D. Roy calls a "safety first" model. The distinctive feature of the decision process is avoidance of excessive loss.[19]

Our model might be viewed as implying a utility function as follows:

$$\begin{aligned} u(E\pi) \quad & \text{when} \quad \Pr(\pi < \pi^*) \leqq \alpha \\ -\infty \quad & \text{when} \quad \Pr(\pi < \pi^*) > \alpha. \end{aligned}$$

An obvious possible modification is to allow some substitutability between $E\pi$ and, say, α. We might postulate a willingness to take greater chances of disaster if the expectation of reward were increased. Instead of the above, we would have

$$u\{E\pi, \Pr(\pi < \pi^*)\}$$

or, more general,

$$u\{E\pi, \pi^*, \Pr(\pi < \pi^*)\}.$$

These modifications are still close to the spirit of the approach we have

[19] Roy has used this kind of approach in constructing a theory of portfolio behavior. Our formulation, which was arrived at independently, may seem more restrictive than Roy's because it is not non-parametric. This feature in fact seems less restrictive to us, since we feel that a decision maker will and should use whatever information is available and that such information may well include knowledge of the shape of relevant probability distributions. (See A. D. Roy, "Safety First and the Holding of Assets," *Econometrica*, July 1952, Vol. 20, pp. 431–449.)

presented. A quite different approach would be to assume a function $u(\pi)$ and to let the maximization of expected utility be the decision criterion.

As pointed out in the text, we feel our approach accurately reflects conditions in meat-packing. In addition, we believe that a strong case can be made for our model on grounds of simplicity, intuitive appeal, and to some extent the arbitrariness itself. We achieve a clear separation of cost and risk considerations, allowing for the operation of either; and only two parameters, π^* and α, need be specified in order to determine reaction to risk. Both of these parameters are understandable and appealing. π^* can be related to the objective financial position of the firm, and subjective elements are summed up in the single measure α. These characteristics make our model particularly attractive as a practical device for controlling inventories.

The main shortcoming perhaps is failure to take account of relations with other activities. A model including these might bear on the question of why the risk premium is so high. This model would permit consideration of a problem beyond the scope of the present study, namely, how inventory risk may affect activities of meat-packing firms other than inventory accumulation itself. Inventory risk may lead firms to curtail other activities, for instance, in order to limit overall risk to the firm.

SYNTHETIC METHOD OF COST ANALYSIS IN AGRICULTURAL MARKETING FIRMS*

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Introduction

MORE and more frequently we see reports of marketing studies that have used the synthetic method of cost analysis. This paper is an attempt to explain what the synthetic method is and how it differs from the statistical description of cost behavior, particularly as used in analyzing the economies of scale. The discussion points out the problems that have been encountered in using the synthetic method, and indicates the kinds of information that the synthetic approach has yielded.

The synthetic technique of cost determination has been lifted largely from the workshop of the industrial engineer, particularly the industrial engineer who combines economics with his technology. The nature of the technique is suggested by its common description as the 'building block' method. The building blocks are the various operations performed upon raw materials in the process of converting them to finished goods. These operations are discrete acts of production and can be analyzed separately. From analysis of these separate operations, an analysis of the complete process of production can be assembled.

This synthetic method has some things in common with cost accounting when costs are estimated by operations. It differs from it importantly in the emphasis on separate determination of physical relationships for each operation, and separate introduction of input cost-rates and prices. As often applied, it shares with cost-accounting methods the problem of arbitrary allocation of overhead among products, operations, and over time.

That it is essentially different from the allocation of all costs among products and departments of a plant may be pointed up by noting that once the input-output relationships of individual operations have been developed by the synthetic method, the costs of hypothetical plants can be determined as readily as those of existing plants.

Theory

The economies-of-scale concept is of course a theoretical concept of the manner in which costs change as the size of a productive organization is

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changed.[1] It embraces the U-shaped curve, which describes how costs per unit of output change with change in rate of output for any one size of plant, and a composite curve showing the least-cost points for a succession of plant sizes from smallest to largest. This composite curve, commonly called the long-run cost curve, is thus an envelope curve delineating the lower reaches of the family of average-cost curves that represents all possible plant sizes and organizations. Determination of the economies of scale in an industry is essentially a problem of determination of the parameters of this particular curve.

Where all factors but one are held constant, the relationship between total inputs of a variable factor and total outputs takes a mildly S-shaped form, indicating that as rate of input increases from zero to a high level output increases first at an increasing rate and then at a decreasing rate.

With every change in method of organizing a plant or changing the fixed plant in even a slight degree, there must be a change in the S-shaped curve describing that input-output relationship. A large number of overlapping curves would appear if every possible permutation and combination of equipment and technique were tried and if an S-shaped curve of total costs as a function of labor input were constructed for each on a single graph. An envelope curve composed of small segments of the curves for particular plants could be drawn around the entire family of overlapping curves. This would be an economies-of-scale curve, encompassing variation in all factors of production.

The envelope curve itself does not, of course, tell us what particular plant organization will permit the achievement of least cost. If curves for many individual plants have been developed and drawn on one chart, and an envelope curve is drawn to surround them, it is possible to determine what particular plant curve will be tangent to the envelope curve at the point of least cost. By checking back on the original data, one can also determine what combination of machinery and labor the curve represents. This is the way envelope curves are determined by the synthetic method.

Let us take an actual example of the application of the synthetic method to determine the input-output relationships of an operation in a fruit packing plant. One of the most common types of operation in manufacturing is in-plant transportation. The techniques of transportation include carrying by hand, hand trucks, conveyors, tractor-hauled trailers,

[1] I have always preferred Boulding's exposition of production theory in *Economic Analysis* (rev. ed.; New York: Harpers, 1948), pp. 669-712. The reprint of Viner's article on "Cost Curves and Supply Curves" in Stigler and Boulding, eds., *Readings in Price Theory* (Chicago: Richard D. Irwin, 1952), pp. 198-232, has made this important classic more available.

and fork-lift trucks. The first step in the analysis is a careful appraisal of what is involved in the operation and a cataloguing of various techniques by which the operation may be performed. The necessary information is developed by inspecting a number of plants and by discussion with plant managers. Standard conditions for performing the operation are defined. The physical equipment required is listed and priced. The manner in which its costs will be charged against actual operation is determined.

The labor inputs must generally be determined by a study of actual work conditions. Various types of time and motion studies may be applied to actual work in packing plants or to work performed under laboratory conditions.[2] A statistical description of the input-output relationship is developed for that particular operational technique. Frequently the data are presented in the form of a multiple regression.[3]

Complete synthesis of the cost structure of a plant requires that every operation or cost element be included. There are some operations for which cost information cannot easily be obtained. It was not feasible, for example, to measure the output of a team of women culling fruit in California packing plants.[4] The act of culling or not culling involves the exercise of judgment on every piece of fruit rather than merely the act of picking up and removing bad fruit. No way is known of measuring the act of judgment. For this operation a standard, or average, input-output relationship had to be used instead of one determined to be the least cost.

No particular difficulty has been encountered in combining individual estimates of costs of different operations at different rates into cost curves for individual plants. It is quite feasible to construct cost curves for a whole family of plants with different scales of output. Once this is done, the economies-of-scale curve is practically determined.

Can Economies-of-Scale Curves be Determined by Statistical Description?

Statistical surveys of individual business firms, however, can furnish

[2] For further discussion relating to this point see L. L. Sammet and B. C. French, "Economic-Engineering Methods in Marketing Research," *This Journal*, Vol. XXXV, December, 1953, pp. 924-930.

[3] For one method of collecting information on labor inputs in plant operations see L. L. Sammet and J. B. Hassler, "Ratio-Delay Method in Processing Plants," *Agricultural Economics Research*, Vol. 3, No. 4, October, 1951, pp. 124-134. For a good example of results that develop from the analysis of operations as performed by several techniques see L. L. Sammet, *Efficiency in Fruit Marketing: Orchard-to-Plant Transportation*, Berkeley: University of California, College of Agriculture, Agr. Exp. Sta., July, 1952, Giannini Foundation Mimeographed Report No. 131, Processed.

[4] R. G. Bressler and B. C. French, *Efficiency in Fruit Marketing: Grading Costs for Apples and Pears*, Berkeley: University of California, College of Agriculture, Agr. Exp. Sta., June, 1952, Giannini Foundation Mimeographed Report No. 128, Processed.

useful information on economies of scale. Surveys generally clearly indicate that firms with large volume have lower unit costs than firms with small volume. Such survey information, however, does not bear directly on the question of economies of scale. In addition, we need to know the shape of the least cost curve along the whole course of the curve.

There are two basic ways for using cost data collected from the records of business firms. One is to treat each plant in the sample as a single observation.[5] A second is to obtain the historical record of costs and output of a plant that has varied output considerably but has maintained an essentially constant technology. Such data can tell us little, however, about the economies of scale. A single plant covers only a small segment of an economies-of-scale curve. In addition, there is no way of telling if the plant was the least-cost plant at any point in the range of output over which it operated; and about all we will learn is how average costs of an existing plant changes with size.

Statistical data of costs in a sample of plants can be used, however, to obtain a rough indication of the economies-of-scale curve; providing we use the general knowledge that the true economies-of-scale curve must lie below the lowest cost points that were observed in the sample of plants. An envelope curve can be drawn that falls below all the observed points; but we have no solid basis for knowing just how far below these observations the curve should be drawn, nor any good indication from the data as to the exact shape the curve should take. Few, if any, approved standards exist for use in the construction of such curves.[6] The main advantage is that the data probably can be collected at a fraction of the cost of a full-scale synthetic study, and the technique can be applied to data from secondary sources.

Important Examples of Building-Block Studies[7]

The first synthetic study of costs in agricultural marketing, aside from some isolated work in the 1920's, was R. G. Bressler's study of country

[5] Some examples of studies of this general type are G. E. Korzan, A. B. Davis, and D. D. MacPherson, *Costs of Distributing Milk in the Portland Market,* Corvallis: Oregon Agr. Exp. Sta. Bul. 510, 1952; L. J. Norton, *Cost of Handling Grain by Illinois Elevators,* Urbana: Illinois College of Agriculture, Department of Agricultural Economics, A. E.-1323, 1940; J. R. S. Jorgens and D. Snodgrass, *Handling-Storing Costs of Country Grain Warehouses in Washington,* Pullman: Washington Agr. Exp. Sta. Bul. 536, 1952.

[6] See H. E. Erdman, "Interpretation of Variations in Cost Data for a Group of Individual Firms," *This Journal,* Vol. 26, 1944, pp. 388-391.

[7] See R. G. Bressler, *Economies of Scale in the Operation of Country Milk Plants;* the twelve University of Connecticut bulletins in the series on *Efficiency of Milk Marketing in Connecticut,* and the Giannini Foundation of Agricultural Economics series on *Efficiency in Fruit Marketing,* of which nine bulletins are now published; D. A. Clarke, Jr., "Costs, Pricing and Conservation in Wholesale Milk Delivery in

milk plants in New England, published in 1942. Six plants varying widely in scale were synthesized in this study on the basis of cost estimates developed from a detailed analysis of eight milk plants covering the same size range. The many elements of noncomparability among actual plants led Bressler to use the synthetic technique.

The same technique was continued in the series of bulletins on *Efficiency of Milk Marketing in Connecticut,* published by the University of Connecticut between 1942 and 1948. In 1947 David A. Clarke, Jr. transplanted the techniques of the Connecticut group to California. He used the synthetic method first in a study of the relative efficiency of tank truck and can collection of fluid milk and later in a series of studies on costs of milk distribution. Bressler and L. L. Sammet at the University of California are currently directing an R. M. A. project on efficiency in the packing of fresh fruit, in which the synthetic technique is being used. The technique has been used with modifications in a study of creamery operations in Iowa.[8] Also, Richard Holton and Robert Branson of Harvard University have used it in a recent study of retail food distribution in Puerto Rico.[9] This study employed the methodology in an attempt to estimate possible gain in marketing efficiency from consolidating small retail food stores into a smaller number of larger units.

By far the most elaborate analysis has been Brewster's study of 67 different synthetic cottonseed oil mills.[10] His study is noteworthy for the elaborateness of its development. Brewster went so far as to calculate the increase in the total supply of cottonseed oil that would result from total conversion of the present predominantly hydraulic type mills to more efficient types, and to estimate the effect of this increased supply on price for cottonseed oil.

Los Angeles" (unpublished Ph.D. thesis, University of California, 1951); D. A. Clarke, Jr., *A Comparative Analysis of the Costs of Operating Milk Collection Routes by Can and by Tank in California,* Berkeley: University of California, Division of Agricultural Sciences, Agr. Exp. Sta., 1947, Giannini Foundation Mimeographed Report No. 91; B. C. French, "Economic Efficiency in California Pear Packing Plants" (unpublished Ph.D. thesis, University of California, 1952); John M. Brewster, *Comparative Economics of Different Types of Cottonseed Oil Mills and Their Effects on Oil Supplies, Prices, and Returns to Growers,* Washington: Govt. Print. Off., 1954, U. S. Agricultural Marketing Service, Marketing Research Report No. 54; S. H. Walker, H. J. Preston, and G. T. Nelson, *An Economic Analysis of Butter-Nonfat Dry Milk Plants,* Moscow: Idaho Agr. Exp. Sta. Bul. 20, 1953; E. H. Ward and H. L. Cook, *Concentrated Milk: Some Aspects of Costs and Acceptance for Retail Distribution* (undated mimeograph, Montana State College); E. L. Baum and D. E. Pauls, *A Comparative Analysis of Costs of Farm Collection of Milk by Can and Tank in Western Washington, 1952,* Pullman: Washington Agr. Exp. Sta. Technical Bul. 10. This list is not exhaustive but it contains some important and representative items.

[8] See J. R. Frazer, V. H. Nielson, and J. D. Nord, *The Cost of Manufacturing Butter: A Study Based on Data From 13 Iowa Creameries,* Ames: Iowa Agr. Exp. Sta. Res. Bul. 389.

[9] I would like to acknowledge Holton's kindness in letting me see the manuscript of this study prior to its publication by Harvard University Press.

[10] See footnote 7.

Critique of the Synthetic Approach in Determination of Costs

The main guiding principle of the building blocks studies is that marketing efficiency depends on having agricultural processing operations in a given industry performed by economic units of the most efficient, least-cost size. The older and more familiar types of statistical studies, expressing average cost per unit of output as a function of the rate of output, provide an alternative technique in obtaining useful information on marketing efficiency. The synthetic studies have a great advantage over the older type studies, however, in offering the possibility of obtaining information on least costs that is consistent with the relevant theory. Once a least-cost type of plant is identified through the synthetic construction of the long-run economies-of-scale curve, more details of plant organization become known than can be discovered in statistical studies whose end result is a regression equation.

The synthetic method is also a statistical technique, of course, since development of input-output relationships involves analysis of data; but one disadvantage of the synthetic method is that the estimates derived from synthesis of several operations are cut adrift from standard measures of statistical reliability. When input-output information on operations has been derived from standard methods of statistical estimation, some measure of the reliability of the component parts is obtainable, and hence an idea is obtained as to the reliability of the result. Estimates from synthetic constructions can be checked only by comparing results with alternative sources of information. Such comparisons are important in a synthetic study as a check for completeness and as a check that the research has not inadvertently omitted some important item of cost.

A strong advantage of the synthetic approach is that it can often be applied in an industry where data are not adequate for a statistical analysis, where price changes or new technology destroyed the usefulness of historical records, or where it is not possible to find a sample of plants operating under comparable conditions at a given time. Even where adjustment of statistical data is possible, a synthetic study may be more satisfactory than compensations for changes in costs, adjustments for varying degrees of utilization, reductions of accounting systems to one standard of comparability, or compensations for differences in the quality or composition of the product of various plants.

Parenthetically the synthetic or building-block technique is flexible and can be used to obtain other cost estimates besides the envelope of the least-cost curves at various levels of rate of output. The technique has been used, for example, to develop average cost curves for plants producing at different rates of output where this information was desired in connection with establishment of controlled prices and marketing margins for fluid milk. The use of the synthetic technique is an alternative in this case

to a regression equation fitted to average cost data collected from a sample of plants. In choosing the method of analysis, points to consider are the satisfactoriness of the statistical data that would have to be used in one case and the availability of plants in which physical relationships could be studied in the other. The importance of having statistical measures of reliability, which would not be available in building-block studies, is another consideration.

Economists may be tempted to avoid the building-block approach because it calls for skills more like those of the industrial engineer than of the economist. The relatively brief list of studies made in agricultural marketing shows that industrial engineers, or persons with engineering training, have often been involved. The extensive work by the Texas engineering experiment station in Brewster's study is an outstanding example. At the same time, it is patent that synthetic studies will yield results of great importance to the economist, which may not otherwise be available, and that the engineer working in his own frame of reference will not develop cost information in the form wanted by the economist.

Unsolved Problems of the Synthetic Method

The inevitability of arbitrary allocation of many joint and overhead costs remains as a point for professional regret. The problem is not solved by the building-block technique.[11]

One difficulty is that output per unit of input depends on many factors besides physical size of plant. Similar plants may differ markedly in efficiency because of differences in management. Because the economies-of-scale curve is an extreme based on the assumption that the optimum managerial decisions have been made, the researcher constructing the curve must know which managerial decisions are appropriate to assume.[12]

Certain assumptions are commonly made, for example, about the economic conditions under which the plant operates. In the California packing house studies a certain length of packing season is assumed and the least-cost plant is determined on the basis of this assumption. If the season were longer, quite different allocations of fixed costs would be made. In certain cases more thoroughly mechanized plants would become more economical because of the increase in the number of days the equipment is used.

[11] There is need to divide many costs among operations in the synthetic studies. How this is done may distort the final determination of costs. There probably is an answer to this difficulty in application of linear programming techniques, which have not as yet been applied in any known study of the building-block type.

[12] Workers paid on piece rates work much faster than hourly workers in California grape packing houses, yet competent managers continue to pay hourly wages without detectable disadvantage. One solution used in the California studies has been to assume that packing done by piece rate is essentially a different product than packing done by hourly rates.

Another difficulty in the building-block method is that the entire manufacturing operation is assumed to be the sum of its component parts and the researcher has great freedom in the manner in which he fits the parts together. The researcher runs the danger of inadvertently ignoring a real problem of coordination involved in measuring the economies of scale existing for reasons other than divisibility of equipment.

The problem of measuring economies of scale is a difficult one. In a typical synthetic study, the high costs of small-scale operation are commonly due to inability to fully utilize certain types of machinery that may operate at very low costs when used to full capacity. Frequently there is an implied assumption, however, that one machine fully utilizing all the labor and other facilities associated with it will have the same per-unit costs as two or more machines, always provided that there are no joint costs in sharing of management, building, etc., and that the machines are fully utilized. This assumption begs one of the questions that economists have been asking for a long time; whether or not there are any diseconomies of scale. None of the synthetic studies has uncovered diseconomies of scale, aside from the zig-zags in cost curves that result from incomplete divisibilities of men and equipment. Theorists have long considered the pyramiding of overhead costs of the head office, and the inflexibilities inherent in a well-developed business bureaucracy, to be major factors in diseconomies of scale. The validity of this idea has not yet been tested in building-block studies.

Similarly, studies using the synthetic technique have had little to say about economies of scale external to the firm and associated with the size of the industry. The synthetic method has not yet been used to shed light on the question of the proper place of the gigantic multiplant processing and retailing firms that have become characteristic of agricultural marketing. From the point of view of public policy, this issue is as important as any in the whole field of marketing efficiency. Are these firms dominant because of their inherent efficiency in physical operations, or because of the competitive advantage they are able to develop from their monopoly power? The technique of the synthetic method is applicable to multiplant firms but it has not been generally applied. Holton's attempt to determine the comparative costs of food distribution in Puerto Rico under two alternative systems of organization of the retail food industries is indicative of a possible organization of such studies.

Conclusions

The synthetic method of cost analysis permits more accurate research determination of the economies-of-scale curve than is possible by any other method. Before the development of the synthetic method, economists put up with such poor substitutes as regressions and hand-drawn

envelopes of scatters of observations, even though they recognized the divergence between the scale-cost relationships they actually obtained and the theoretical models. Until the synthetic method was developed, the concept of the economies-of-scale curve remained one of that vast array of intuitive notions for which economists had never been able to find a solid link to reality. Yet the concept of economies-of-scale curve has been and remains of great importance as a guidepost to entrepreneurs and policy makers.

The envelope nature of the economies-of-scale curve must always be borne in mind. Also it must not be forgotten that the curve reflects a phase of each possible way of producing a certain commodity. This means that in the determination of the economies-of-scale curve it is not possible to restrict ourselves to the study of actual plants, which only in fortunate circumstances of exceptional physical organization and exceptional management will be operated at the least possible costs at any given scale.

A number of points have arisen in synthetic studies that are likely to have an impact on the thinking of production theorists. First, the synthetic studies have emphasized the discontinuities that appear in cost curves because of the incomplete divisibilities of men and machines. Although discontinuities have always been recognized, the usual custom has been to ignore them in textbook presentation of cost curves. A man working at a given machine, or a machine itself, has an absolute maximum rate of output. The average cost at rates of output just in excess of this absolute maximum may be substantially higher than the per-unit costs at just the maximum rate. A discontinuity appears in the least-cost curve of a given plant, and the discontinuity is carried over to the envelope curve.

Second, one of the surprises in synthetic studies has been the discovery that once a least-cost position is established, fairly important changes are required in the cost rates of factors of production before a major adjustment in the plant organization will yield a new and lower least-cost combination. This stickiness is a by-product of the discontinuities of production functions.

Third, synthetic studies generally have had fairly broad objectives. In many studies, such as Brewster's and the series on efficiency of milk marketing in Connecticut, the scope of the studies has been such as to suggest reorganization of an entire industry or area. The Connecticut series developed a plan for the most efficient organization of collection, processing, and distribution of fluid milk in a large area and compared the probable efficiencies under the new plan with the existing system. Brewster's work involves cottonseed oil plants of the entire United States.

In his study costs per unit of output decline continuously to the largest scale of plant included in the analysis. This scale is so large that fundamental changes in organization of the cottonseed oil industry would be required to establish mills operating at least cost. Such a far-reaching reorganization would also change the competitive structure of the industry.

Finally, the building-block studies have been too few in number to support firmly any broad generalization as to the shape of a typical economies-of-scale curve for an industry. If what we have observed continues to be evidenced in future synthetic studies, the view will be supported that as scale is increased the economies-of-scale curve continues to decline asymptotically to some minimum level. Synthesized costs of small plants generally turn out to be comparatively high and, as scale is increased, costs at first fall rapidly, then less rapidly to a point of leveling off.

DISCUSSION

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The paper by Professor Suits is an excellent example of the application of modern econometric methods to concrete data. He has followed a common practice in trying out several models before choosing one particular model as the most adequate. I think it should be emphasized that such a procedure, however commendable from the economic point of view, introduces statistical difficulties because biasses arise. This influences the standard errors indicated in his study. The moderate success of his model for forecasting may perhaps be explained by the linearity assumptions, which are very unlikely to hold over the whole range of the functions estimated.

In respect to the paper by Tolley and Harrell, it would be interesting to explore the relations of this decision model with economic models, e.g., proposed by Shackle and Kalecki. On the other hand, statisticians have recently employed similar models, for instance Blackwell and Girshick, and Savage.

Concerning finally the paper by Black, I think it is important to note the relation of the methods proposed to linear programming methods. Both have in common that they push the analysis back into the technological field and are able to deal with the very choice of the technological methods actually employed from a whole array of possible technologies. This is a great progress compared with traditional methods of the economic analysis of production.

RESALE MILK PRICE CONTROL—OUTMODED AND ANTISOCIAL?*

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AS PART of the current general reaction against governmental support and control of agricultural prices, questions are being raised as to the role of state and federal governments in fixing prices for fluid milk. Most of these questions are directed toward the fixing of prices at the resale or consumer level. (There seems to be rather general agreement that some form of price fixing is desirable at the producer level.) This means that major criticism falls on those states with retail price control, which in January 1955 included Maine, New Hampshire, Vermont, Rhode Island, New Jersey,[1] Pennsylvania, Virginia, Georgia, Florida, Alabama, Montana, and California.

The problem was given national prominence in a recent issue of *Time* magazine by a special article entitled "Milk Pricing—Housewives Pay for Outmoded Controls."[2] The lead paragraph of this article notes that "The big reason U. S. milk consumption is no higher is that milk markets all over the nation have been saddled with monopolistic controls that create artificially high prices, thus cut consumption." It points out that state milk control has recently been revoked in Oregon and is being challenged in Florida, California, and Pennsylvania. It quotes Professor R. W. Bartlett of Illinois to the effect that, in a study of 50 markets, ". . . prices were invariably higher where state controls existed . . ." and that ". . . modified federal regulation is absolutely essential to [prevent] chaos in milk marketing. [But] state control of consumer prices constitutes a legalized monopoly which is definitely against the public interest."

It is not the purpose of this paper to debate the merits of government controls either in general or specifically with reference to resale milk prices. Rather, we wish to re-examine the factual bases for some of the Broad conclusions quoted in the above and similar articles and thus attempt to provide a more objective basis on which to judge the case for or against milk price control. We direct our attention entirely to the problem of resale pricing, thereby limiting our major considerations to comparisons of price spreads between producer and consumer in controlled and noncontrolled markets.

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[1] Retail price controls on milk ended in New Jersey on February 15, 1955.

[2] *Time* magazine, December 13, 1954, p. 88.

Before considering such comparisons, it is well to stress some of the limitations involved in using price and price spread comparisons as measures of relative efficiency in milk distribution. For the most part, milk distribution in the major cities of the United States is largely influenced by local rather than regional or national conditions. Resale prices may differ among markets because of differences in the basic prices for fluid milk at the producer level. We can eliminate this factor by comparing distribution price spreads—the charges made by distributors and storekeepers for the services they perform in processing, delivering, and selling milk. But many other differences remain. We know that wage rates and other important cost items are not constant from market to market. We know that natural conditions, such as topography and delivery density, vary from market to market and that these can be expected to affect route volumes and delivery costs. We know that size of firm varies widely and that size is an important determinant of costs. We know that delivery volumes per customer—retail and wholesale—differ among markets, as do the proportions of milk sold in wholesale and retail operations, and that such differences influence average costs.

For these and similar reasons, we cannot conclude that milk distribution in one market is more efficient than in another simply because typical price spreads are narrower. We should like to compare actual prices in such markets with some ideal prices that would reflect uniformly efficient operations within the limits imposed by local market conditions. Since this is not possible, we are forced to rely on price spread comparisons, and hope that the impact of these local factors will about average out in comparisons based on relatively large numbers of markets. Moreover, we compare markets with and without state controls, in spite of the fact that controls are far from homogeneous with respect to legal provisions or enforcement procedures.

The tables that follow compare distribution price spreads for fluid milk in 100 major markets in the United States. Basic data for these comparisons have been drawn from statistics issued by the U. S. Department of Agriculture, and *all* markets have been included for which complete data were reported for January, 1954.[3] The 100 markets so reported include 33 operating under state resale price controls and 67 without such governmental controls. Table 1 summarizes the price spreads reported for these markets by frequency distributions and averages. Table 2 gives a condensed summary in terms of ranges and averages for the same markets with the total subdivided into six classes based on market population. This subclassification was used in an attempt to reduce the effects of

[3] U. S. Agricultural Marketing Service, *Fluid Milk and Cream Report*, January, February, and March, 1954. Washington, D.C.

TABLE 1. PRICE SPREADS IN MILK DISTRIBUTION IN UNITED STATES CITIES: 33 MARKETS WITH RESALE MILK PRICE CONTROL AND 67 MARKETS WITHOUT GOVERNMENT CONTROL, JANUARY, 1954

Retail margin			Wholesale margin			Store margin			Store differential				
										Single quart[a]		High[b]	
Cents per quart	With control	Without control	Cents per quart	With control	Without control	Cents per quart	With control	Without control	Cents per quart	With control	Without control	With control	Without control
	Number of cities			Number of cities			Number of cities			Number of cities		Number of cities	
7.5– 7.9	—	1	5.5– 5.9	—	1	0.0–0.4	—	—	0.0–0.4	20	49	14	19
8.0– 8.4	—	—	6.0– 6.4	—	—	0.5–0.9	—	1	0.5–0.9	—	4	5	8
8.5– 8.9	1	1	6.5– 6.9	2	4	1.0–1.4	1	1	1.0–1.4	11	10	11	11
9.0– 9.4	2	2	7.0– 7.4	6	9	1.5–1.9	4	8	1.5–1.9	2	2	3	8
9.5– 9.9	—	6	7.5– 7.9	4	7	2.0–2.4	21	22	2.0–2.4		2		11
10.0–10.4	8	8	8.0– 8.4	6	6	2.5–2.9	6	16	2.5–2.9				3
10.5–10.9	12	6	8.5– 8.9	11	11	3.0–3.4	1	13	3.0–3.4				1
11.0–11.4	7	9	9.0– 9.4	3	10	3.5–3.9		5	3.5–3.9				1
11.5–11.9	1	14	9.5– 9.9	—	11	4.0–4.4		1	4.0–4.4				—
12.0–12.4	1	10	10.0–10.4	—	3				4.5–4.9				3
12.5–12.9	—	3	10.5–10.9	1	4				5.0–5.4				2
13.0–13.4	1	5	11.0–11.4		—								
13.5–13.9		1	11.5–11.9		—								
14.0–14.4		—	12.0–12.4		—								
14.5–14.9		—	12.5–12.9		1								
15.0–15.4		—											
15.5–15.9		—											
16.0–16.4		—											
16.5–16.9		1											
Simple average price spreads[c]													
	10.7	11.3		8.2	8.6		2.1	2.4		0.4	0.3	0.5	1.3

[a] Based on difference between reported home-delivered and store prices for single-quart sales.
[b] Based on difference between single-quart, home-delivered price, and lowest reported out-of-store price—usually a multiple-unit price.
[c] Averages calculated from original data and may not reconcile due to rounding.
Source: U. S. Agricultural Marketing Service, *Fluid Milk and Cream Report*, January, February, and March, 1954. Washington, D. C.

TABLE 2. SUMMARY OF PRICE SPREADS FOR FLUID MILK DISTRIBUTION IN MARKETS WITH AND WITHOUT RESALE PRICE CONTROL, BY MARKET SIZE, JANUARY, 1954

Type and size of market[a]	Price spreads[b]						Number of markets
	Retail	Wholesale	Store	Wholesale plus store	Store differential[c]		
					Single quart	High	
	cents per quart of milk						
Population 0–49,999							
With control:							
Average	10.3	7.9	2.1	10.0	0.3	0.4	7
Range	9.3–11.1	7.1–8.6	2.0–2.5	9.1–10.6	0.0–1.0	0.0–1.0	
Without control:							
Average	10.3	7.8	2.3	10.1	0.2	0.9	11
Range	7.8–12.1	5.8–9.7	1.0–3.0	7.8–12.1	0.0–1.0	0.0–3.5	
Population 50,000–99,999							
With control:							
Average	10.7	8.6	1.9	10.5	0.2	0.3	8
Range	9.2–13.2	7.2–10.8	1.5–2.3	9.2–12.3	0.0–1.0	0.0–1.0	
Without control:							
Average	11.6	9.1	2.4	11.5	0.1	1.0	15
Range	8.7–13.2	6.7–10.7	2.0–3.5	8.7–13.2	0.0–1.0	0.0–4.5	
Population 100,000–199,999							
With control:							
Average	10.8	8.2	2.2	10.4	0.4	0.5	5
Range	10.4–11.1	7.2–8.9	2.0–2.5	9.4–11.1	0.0–1.0	0.0–1.0	
Without control:							
Average	11.6	8.8	2.5	11.3	0.3	1.1	18
Range	9.3–16.6	6.5–12.6	1.5–4.0	8.6–14.7	0.0–2.0	0.0–2.5	
Population 200,000–399,999							
With control:							
Average	10.6	8.1	2.1	10.2	0.4	0.5	8
Range	8.8–11.4	7.2–8.8	1.5–3.0	9.4–11.4	0.0–1.0	0.0–1.0	
Without control:							
Average	11.5	8.9	2.3	11.2	0.4	1.4	10
Range	10.5–13.5	7.5–10.5	1.5–3.5	9.1–12.5	0.0–1.5	0.0–5.0	

[a] Market size based on 1950 population data.
[b] All averages are simple averages, not weighted by marked size or volume of sales.
[c] The "high" store differential refers to difference between single-quart, home-delivered price, and the lowest reported out-of-store price—usually a multiple-unit price
[d] Both markets report high store differential at 4.5 cents.
Source: Based on reports of the U. S. Department of Agriculture.

[a] Averages calculated from original data and may not reconcile due to rounding.
Source: U. S. Agricultural Marketing Service, *Fluid Milk and Cream Report*, January, February, and March, 1954. Washington, D. C.

TABLE 2—(*Continued*)

Type and size of market[a]	Price spreads[b]						Number of markets
	Retail	Wholesale	Store	Wholesale plus store	Store differential[c]		
					Single quart	High	
	cents per quart of milk						
Population 400,000–999,999							
With control:							
Average	11.6	8.6	2.2	10.8	0.8	1.3	3
Range	11.0–12.3	7.5–9.3	1.5–2.5	10.0–11.6	0.0–1.5	0.0–1.5	
Without control:							
Average	11.2	8.3	2.2	10.6	0.7	1.9	11
Range	9.6–13.4	7.1–10.9	0.5–3.5	8.7–12.9	0.0–2.0	0.5–5.0	
Population 1,000,000 and over							
With control:							
Average	10.7	7.6	1.8	9.4	1.2	1.2	2
Range	10.6–10.8	6.6–8.6	1.2–2.5	9.1–9.8	1.0–1.5	1.0–1.5	
Without control:							
Average	11.8	9.1	2.2	11.4	0.5	4.5	2
Range	11.5–12.2	8.5–9.7	1.5–3.0	11.2–11.5	0.0–1.0	—[d]	
All markets							
With control:							
Average	10.7	8.2	2.1	10.3	0.4	0.5	33
Range	8.8–13.3	6.6–10.8	1.2–3.0	9.1–12.3	0.0–1.5	0.0–1.5	
Without control:							
Average	11.3	8.6	2.4	11.0	0.3	1.3	67
Range	7.8–16.6	5.8–12.6	0.5–4.0	7.8–14.6	0.0–2.0	0.0–5.0	
Grand total:							
Average	11.1	8.5	2.3	10.8	0.3	1.0	100
Range	7.8–16.6	5.8–12.6	0.5–4.0	7.8–14.6	0.0–2.0	0.0–5.0	

some of the factors that vary from market to market, since there is some tendency for such factors as wage rates, delivery conditions, size of firm, and relative importance of retail and wholesale deliveries to be associated with market size.

The data in these tables illustrate the wide range in price spreads within all market and type of control classifications and the relatively small differences in the "between group" averages. The data provide no significant evidence that price spreads for milk distribution are wider in markets with state control than in markets where resale prices are established without direct government participation. In fact, the reverse

seems to be true, although the noted ranges in price plus some probable limitations of the basic price reports makes the observed average differences of questionable significance. The range of variability is greater in the markets without control than in those with resale price control. As shown in Table 1, both the widest and narrowest margins—for retail, wholesale, and store—are in the "uncontrolled" markets.

With respect to home-delivered milk, price spreads or margins in 33 sample controlled markets averaged 0.6 cent per quart narrower than in 67 unregulated markets, and average margins were as narrow or narrower in controlled markets for 5 of the 6 groups based on market population. Wholesale price spreads averaged 0.4 cent per quart narrower in controlled than in uncontrolled markets, and the averages for controlled markets were narrower in 4 of the 6 market groups. Price spreads to cover store operations averaged 0.3 cent per quart narrower in controlled markets than in uncontrolled, and controlled market averages were as narrow or narrower in all 6 of the market groups. The combination of wholesale-plus-store price spreads represents the total spread between producer and consumer for this channel of distribution. These combination price spreads averaged 0.7 cent per quart narrower for controlled markets than for uncontrolled markets, and margins in controlled markets averaged narrower in 5 out of 6 market groups.

Differentials between home-delivery and out-of-store prices, based on single-quart deliveries and single-quart containers, averaged 0.1 cent per quart higher in controlled than in uncontrolled markets, and controlled markets were higher in 5 out of 6 market groups. A *higher* differential means a greater difference between home-delivered and out-of-store prices.

Uncontrolled markets were more flexible in out-of-store pricing with more frequent and larger price discounts for multiple-unit sales. Using the lowest reported out-of-store prices (rather than the single-quart price), the average store differential for 67 unregulated markets was 0.8 cent per quart higher than the average for 33 controlled markets. Moreover the uncontrolled market store differentials averaged higher in each of the 6 market groups. These higher differentials were very much influenced, however, by 7 markets with maximum store differentials ranging from 3.0 to 5.0 cents per quart. We have no information on the proportion of market sales at the several prices reported for such markets, and can only say that some consumers were able to and did obtain their milk from stores at these relatively low prices in some unregulated markets.

It is interesting and significant to note that higher average store differentials in such markets result from *wider* average retail price spreads and more flexible store margins and *not* from narrower price spreads in

wholesale operations. The general conclusion from these comparisons is that distribution price spreads tend to be narrower in controlled than in uncontrolled markets. Differences are not great, however, and price spreads in individual markets vary widely around the averages, with some tendency for uncontrolled markets to be more variable than controlled markets. These data do not *prove* that resale price control results in narrower price spreads, but they certainly place a heavy burden of proof on anyone who makes the general claim that controls result in higher costs and charges.

These results are in sharp contrast with the conclusions of the above-

TABLE 3. SUMMARY OF PROFESSOR BARTLETT'S 50-MARKET STUDY[a]

Market group	November, 1953		Net difference between home-delivered and lowest reported store prices					Number of markets
	Home-delivered price	Lowest reported store price	November		1949	1939	1929	
			1953	1952				
	cents per quart							
Group A. State-controlled cities:								
Average	24.1	23.6	0.5	0.4	0.3	0.4	0.5	18
Range	20.0–27.0	20.0–27.0	0.0–1.5	0.0–1.5	0.0–1.0	0.0–2.3	−1.0–3.0	
Group B. Cities not under state control; potentially competitive markets:								
Average	23.4	21.8	1.6	0.8	0.6	1.2	0.7	15
Range	21.0–26.5	16.0–26.0	0.0–5.0	0.0–1.0	0.0–1.5	0.0–3.0	0.0–2.4	
Group C. Cities not under state control; competitive markets:								
Average	23.2	20.1	3.1	2.7	1.8	1.1	1.0	17
Range	19.0–27.0	16.0–24.0	1.5–6.8	1.5–5.0	0.0–4.1	0.0–2.8	−0.7–5.0	

[a] Condensed from Table 1, p. 1511, *Illinois Farm Economics*, No. 219, March, 1954.

reported *Time* article. On the assumption that the variations might stem from differences in the sample markets used or the particular time period involved, we turned to Professor Bartlett's quoted study of 50 markets.[4] In this study, Bartlett divided his 50-market sample into 3 groups: Group A, including 18 state-controlled cities; Group B, 15 cities not under state control and labeled "potentially competitive markets"; and Group C, 17 cities not under state control and labeled "competitive markets." The difference between Group B and Group C is entirely in terms of the magnitude of the *maximum* store differential in November, 1952. Group B markets had store differentials of 1 cent per quart or less, while Group C markets had maximum store differentials in excess of 1 cent per quart. A summary of Professor Bartlett's price comparisons for these market groups is given in Table 3.

[4] Bartlett, R. W., "Is State Control of Consumer Prices of Milk in the Public Interest?" *Illinois Farm Economics*, No. 219, March, 1954, pp. 1509-1512.

Several comments are in order concerning this summary. First, it is clear that prices and store differentials varied widely in these markets and that some controlled markets had much lower prices than were reported for some noncontrolled markets. This means that any sweeping generalizations about controlled vs. noncontrolled markets are not clearly supported by the data, and certainly no basis exists for such statements as ". . . prices were invariably higher where state controls existed. . . ." Second, Bartlett is concerned with state control of resale prices, but his data refer not to price spreads but to absolute levels of prices and to store differentials. Certainly the public interest is not confined to purchase of milk through stores and to these particular outlets that report lowest store prices. If we want to consider the impact of resale price control, then comparisons should be based on the spreads between producer and resale prices and should consider home delivery as well as store sales. Finally, the classification of noncontrolled markets into a so-called "competitive" group based on the existence of high-store differentials is an arbitrary and biased procedure. If we are interested in making objective statements about the characteristics of controlled and noncontrolled markets, there is no more justification for such a classification of noncontrolled markets than there would be, for example, in limiting the controlled markets to those with relatively low home-delivered prices.

For the above reasons, we have recomputed the price information for a number of Bartlett's markets on a basis conforming with the data presented in Tables 1 and 2. We have limited our calculations to Group A and Group C, for here the bias in selection will be *most disadvantageous* to the controlled market group. We have used all markets in these two groups for which complete price data could be obtained for November, 1953, from the *Fluid Milk and Cream Report*. Finally, we have reported the single-quart store differential as well as the maximum store differential. The results of these calculations are given in Table 4.

These calculations throw an entirely new light on the comparisons of controlled and uncontrolled markets. It is true that the data in Table 4 show higher store differentials for Group C markets than for Group A markets; but this is merely a reflection of the peculiar way in which Group C markets were selected. An examination of average distribution margins for the two groups of markets casts serious doubt on any claim for superior "efficiency" in the Group C markets. To begin with, producer prices—not given in this tabulation—are considerably higher, on the average, for the controlled markets than for the uncontrolled markets in these groups—13.8 cents per quart in the controlled markets and 11.5 cents per quart in the uncontrolled markets. Whether or not these higher prices reflect the type of control *at the producer level* need not concern us here,

TABLE 4. REPORTED PRICE SPREADS FOR BARTLETT'S GROUP A AND GROUP C MARKETS, NOVEMBER, 1953[a]

Group and market	Price spreads[b]					
	Retail	Wholesale	Store	Wholesale plus store	Store differential	
					Single quart	High
	cents per quart					
Group A. State-controlled cities:						
Newark	11.9	9.4	1.0	10.4	1.5	1.5
San Francisco	11.0	7.5	2.5	10.0	1.0	1.5
Los Angeles	10.7	6.7	2.5	9.2	1.5	1.5
Mobile	10.7	8.5	2.2	10.7	0.0	1.2
Philadelphia	10.9	8.4	1.5	9.9	1.0	1.0
Pittsburgh	11.6	8.1	2.5	10.6	1.0	1.0
Providence	9.8	6.8	2.0	8.8	1.0	1.0
Portland, Oregon	8.9	7.4	1.5	8.9	0.0	0.5
Atlanta	10.5	8.0	2.5	10.5	0.0	0.0
Birmingham	10.9	8.7	2.2	10.9	0.0	0.0
Jacksonville	11.4	8.4	3.0	11.4	0.0	0.0
Manchester	10.1	7.6	2.5	10.1	0.0	0.0
Norfolk	10.2	8.2	2.0	10.2	0.0	0.0
Portland, Maine	9.9	7.4	2.5	9.9	0.0	0.0
Richmond	10.0	8.0	2.0	10.0	0.0	0.0
Savannah	10.8	8.3	2.5	10.8	0.0	0.0
Average[c]	10.6	8.0	2.2	10.2	0.4	0.6
Group C. Cities not under state control; competitive markets:						
Chicago	16.3	10.8	1.5	12.3	4.0	6.8
New York	12.8	10.3	1.5	11.8	1.0	4.5
Minneapolis	11.5	8.5	1.0	9.5	2.0	4.0
Milwaukee	11.5	9.0	1.5	10.5	1.0	3.5
Kansas City, Mo.	10.9	6.9	1.0	7.9	3.0	3.0
St. Paul	9.5	8.0	1.5	9.5	0.0	3.0
Washington, D. C.	9.8	7.3	0.0	7.3	2.5	3.0
Boston	10.6	7.6	1.0	8.6	2.0	2.5
St. Louis	11.6	8.1	1.5	9.6	2.0	2.5
Louisville	12.2	8.2	3.0	11.2	1.0	2.0
Seattle	9.7	7.2	1.5	8.7	1.0	2.0
Buffalo	12.5	9.5	1.5	11.0	1.5	1.5
Denver	11.0	8.0	1.5	9.5	1.5	1.5
Salt Lake City	10.1	6.6	2.5	9.1	1.0	1.5
Average[c]	11.4	8.3	1.5	9.8	1.7	3.0

[a] Based on data from the *Fluid Milk and Cream Report*, U. S. Agricultural Marketing Service.

[b] Price spreads refer to reported prices for single-quart purchases in all cases except the "high" store differentials. The "high" differentials are based on the lowest reported out-of-store prices for these markets.

[c] Simple averages; may not reconcile exactly due to rounding.

for we are interested in the effects of resale prices on distribution margins. We may note, however, that most of the controlled markets are in the Atlantic Seaboard areas while most of the uncontrolled markets are in the midwestern surplus dairy area. Natural conditions and

location would lead us to expect somewhat higher prices in this eastern area under completely competitive market structures.[5]

In terms of distribution price spreads, the data indicate that these controlled markets operate with *narrower* margins on the average than do the supposedly more efficient uncontrolled markets. Thus, the spread between producer prices and home-delivered prices averages 10.6 cents per quart for the controlled markets and 11.4 cents per quart for the uncontrolled markets. Similarly, the spread between producer prices and wholesale prices averages 8.0 cents in controlled markets as compared with 8.3 cents in uncontrolled markets. The margin between wholesale and out-of-store prices on single-quart sales is narrower in the uncontrolled markets—1.5 cents as compared with 2.2 cents per quart—and the store differentials are higher as mentioned above. Even for these highly selected markets then, it appears that average charges to cover the processing and delivery operations of milk distributors are lower with resale price control than they are where the industry is allowed to compete without such restraints.

In no small measure, higher store differentials in the uncontrolled markets result from the relatively *high charges for home delivery in these markets.* If we are to draw conclusions as to the effects of resale price control from these data, the only fair generalizations seem to be that controlled markets, on the average, have narrower price spreads in home delivery but wider margins for wholesale-plus-store operations (due to wider store margins in this particular group of 30 markets), and that uncontrolled markets tend to have higher and more flexible store price differentials. In fact, we doubt that these generalizations can be accepted as of great value due to inherent differences among markets, to the biased selection of the uncontrolled market group, and to the heterogeneity of resale price controls themselves.

It is interesting to compare two northwestern cities in this table—Portland and Seattle—especially since the *Time* article singled out Oregon as a state where arbitrary pricing procedures had recently resulted in the repeal of state control, and Washington as a state where the Director of Agriculture advocates price control to protect the dairy farmer at the producer level but only to permit ". . . efficient distributors to pass their savings on to housewives." These data indicate that the efficient distributors in Seattle were charging 0.8 cent per quart more for home delivery while wholesale-plus-store spreads were 0.2 cent narrower on single-quart purchases. On the other hand, if the protection of dairy

[5] Bredo, William and Anthony S. Rojko, *Prices and Milksheds of Northeastern Markets* (Amherst: 1952), Massachusetts Agricultural Experiment Station Bul. 470. Northeast Regional Pub. 9, p. 10.

farmers means lower prices, Seattle accomplished this by a producer price of 10.8 cents per quart as compared with 13.1 cents for Portland.

These results may come as a surprise to those who assume that the main purpose of resale price control is to enhance returns to milk distributors. Several general observations may be made in this connection. First, it is a mistake to assume that conditions in controlled markets would approximate pure and perfect competition if state controls of resale prices were abolished. For many years market structures in fluid milk distribution have differed significantly from the free market conditions that economists label competition. As a result, fluid milk prices are "administered prices" under "uncontrolled" as well as "controlled" market conditions where the latter refers to the existence of government price-fixing provisions.

When and where resale price controls were adopted, they gave formal recognition to already well-developed market practices, and perhaps their major influence was to implement these voluntary practices that had broken down under pressure of depression. In comparing controlled and uncontrolled markets we need to remember: (1) that we are comparing government-controlled markets with *actual* markets operating without controls of this type, and not with some ideal of perfect efficiency; (2) that in some industries, such as the public utilities, we have long recognized that market structures and technological conditions are incompatible with a close approximation of competition in the economic sense, and *perhaps* this is true in fluid milk distribution; (3) that the addition of a public agency to the price-making process in such industries *may* add some consideration for the general welfare and somewhat restrain forces of a monopolistic or bilateral monopolistic nature; and (4) that in some states the resale pricing statutes have stressed efficiency, and these standards probably have had some influence on pricing policies.

Perhaps we may be permitted to make some personal and largely unsupported observations. First, we believe that the competitive forces of free markets can be important instruments in the growth and development of economic efficiency. Second, we believe that governmental controls should be avoided in industries where technological and institutional factors suggest a reasonably close approximation to competitive conditions. Both of these points strongly support the conclusion that controls of any type are "undesirable" unless a clear need is demonstrated. As a third factor, however, we recognize that in certain industries—and possibly fluid milk distribution—market structures depart significantly from competitive conditions; in these industries, we believe that intelligently designed and administered government controls could be a positive instrument for improvement in the efficiency of the system. Fourth,

we feel that control procedures could be designed to reflect cost differences and to give a maximum scope for the operation of competitive forces *within* the framework of regulations and controls. We readily admit that important limitations of resale milk price controls must be recognized. As pointed out by Hammerberg, arguments that resale price fixing is necessary to insure adequate protection of producer price-fixing programs have been demonstrated to be fallacious.[6] This is clearly evidenced by the federal milk marketing order program and state controls over producer prices such as are in effect in Connecticut. Professor Spencer emphasizes that resale controls create enforcement difficulties of substantial magnitude.[7] Resale price control can and has caused serious distortions in market structure as evidenced by the development of the "captive creameries" and "captive supermarkets" in California. In this case, however, the problems appear to be brought about more by the types of pricing procedures used than as a direct consequence of price controls.

To summarize, we cannot agree with those who argue against controls and, at the same time, encourage the development of unregulated monopolistic practices under the name of "self-help" programs. We do not agree that there is convincing evidence that resale price control in fluid milk distribution has resulted in wider distribution margins and in injury to the general welfare, and we take sharp exception to reports that use misleading and biased analyses to support such contentions. Finally, we believe that it is possible to develop regulations and controls in fluid milk markets—at both producer and consumer levels—that would be positive instruments in encouraging the development of efficiency and so in improving some aspects of welfare, but we admit to some doubt that most controls will depart far from typical conditions in uncontrolled markets.

[6] See the *Proceedings of the International Association of Milk Control Agencies*, Eighteenth Annual Meeting, Atlanta, Georgia, 1954, pp. 85-86.

[7] *Ibid.*, pp. 66-67.

FARM POLICY: THE CURRENT POSITION*

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I

FARM policy has long been a serious source of discouragement to those who believe that, with thought and effort, public problems, however intractable, can be made to yield, however gradually, to solution. Such discouragement must seem deeply justified at the moment. We have just come through a notably agonizing reappraisal of our farm policy. First, beginning in 1953, there was a lengthly period of conference and discussion. Those whom the new Administration agreeably characterized as "the best minds" were consulted at length and called on for a program. The people in general, and the Congress in particular, were promised that the result would be a new and fresh approach to this old and tired problem. The Congress also made a notable effort to inform itself. Then, during the 1954 session of Congress, the Administration presented its proposals, and these were debated at great length. Eventually, the proposals, intact in broad outline, were enacted into law. The whole issue was then reviewed in the election campaign of 1954.

This was a formidable effort. One is all but compelled to suppose that something important was accomplished. Herein lies the reason for the peculiar discouragement of the moment. Under the new farm bill the country can reasonably expect to have all of the troubles that afflicted it under the old one. Despite all of the effort no substantial problem of past farm policy was solved or greatly mitigated. This is distressing, but the point is readily established.

II

There were many criticisms of the program that had been developed prior to the Agricultural Act of 1954. These ranged from the complaint that it did least for those farmers who most needed help to the conviction that it did things for all farmers that the government shouldn't do at all. It was said to be working damage to the structure of the society, the moral fiber of the farmers, and the spiritual fabric of the Republic. Some of this damage, though still admittedly invisible to the average citizen, was even considered decisive by the scholars who drew attention to it. However, for testing the corrective effects of the new farm program not much can be done with those faults of the old program which are faults only as a matter of ideological preference. And we must also pass by those

* This is a much revised version of a paper first given before the Graduate School of the U. S. Department of Agriculture on December 1, 1954.

consequences which, however evil they seem to those who aver them, are nonetheless wholly hypothetical. As a practical matter, attention must be confined to those shortcomings of the old program which were matters of solid experience and to their fate under the new legislation.

There were four faults of the old program which were of commanding importance. I venture to suggest that there would be a considerable measure of agreement on the list as follows:

(1) The Surplus Problem. In the process of supporting farm prices, the government, through the Commodity Credit Corporation, has had to acquire large inventories of products which it did not want, for which it did not have a plan for handling and disposing, and which cost money to store or, in some spectacular instances, couldn't be stored. Most recent Secretaries of Agriculture would undoubtedly identify the surplus problem as the worst of their woes under past farm programs.

(2) The Controls Problem. As surpluses became embarrassing under past programs, it became necessary to impose acreage allotments and marketing quotas. These involved a sizeable administrative apparatus and were otherwise unwelcome. While the experience is not entirely conclusive, it seems likely that, apart from tobacco and cotton, they also presented a serious dilemma. Either the controls were politically acceptable and not very effective, or they were effective and politically disagreeable. The recent experience with controls over diverted acreage and its abandonment during the election campaign suggests the nature of the difficulty.

(3) The Trade Problem. Under past programs, export products often had to be subsidized if they were to maintain their place in world markets. Otherwise there was danger that the supported price at home would gradually (or rapidly) retire the products from competition in world markets. Imports of products subject to the support-price program had to be limited by quota to keep the farmers of the world at large from taking advantage of American generosity. These export subsidies and import quotas were sharply in conflict with our official policy and pretensions on world trade.

(4) The Discrimination Problem. The past programs provided a large measure of price security for wheat, cotton, corn, rice, tobacco, and peanuts, slightly less for dairy products, some feeds and oilseeds, and no price security at all for many other products. As a result, a farmer often had his feed costs pegged while his product was subject to the rigors of the open market. Products in substantial surplus, like wheat, enjoyed nearly perfect price security while nutritionally more important alternatives or products which better served the ends of soil and water conservation—the products of grassland agriculture, for example—enjoyed less or no price protection. The decision on whether a product would receive support depended not on logic but on history, politics, and the infinitely important detail of whether or not it would keep when stored.

III

Such were the faults of the old program. As a matter of preference some might add others; few would deny the importance or even the

urgency of those mentioned. The disconcerting fact is that the new farm program corrects none of these shortcomings.

On two points there can be no argument. There will continue to be one policy for basic or storable products and another for non-basic or perishable commodities. There is a case that the degree of discrimination is slightly reduced; however, the principle of discrimination is as fully accepted in the new legislation as in the old. The effect of the farm program on international trade is also unchanged. It is the fact of support prices rather than their precise level which necessitates export subsidies and import restrictions. That the supports are "flexible" makes no difference. As this is written, plans are being perfected for overseas disposal on an unprecedented scale.

But the even more obtrusive problems of government-owned surpluses and of controls also remain untouched except as one may be willing to embrace some rather breath-taking assumptions concerning the elasticity of the demand and supply functions for farm products.

The prospective reduction in the levels of price supports under the sliding-scale arrangements and with the new parity depends on administrative decisions, and hence it cannot be projected with certainty. However, except for wheat there is wide agreement that it will be relatively small. In the next year or two there will be no change in tobacco supports; the change for cotton, peanuts, and rice (if quotas are voted) will be nominal. There will be a slightly more important change for corn. During 1955 wheat supports will drop eighteen cents from $2.24 to $2.06 a bushel and thereafter the combined effect of the shift to the new parity which is lower for wheat and of continued large supplies could bring a significant further reduction. Wheat, however, is the exceptional case. During the congressional debates, and more especially during the ensuing election campaign. Administration spokesmen emphasized that no farmer would be much "hurt" by the new prices. This, on the whole, was a legitimate claim.

However, since there will be little pain from the new program, it follows that there will be little or no effect on production.[1] This must certainly be expected in any non-mystical view of the matter where there is no appreciable price change. But even where prices fall, as in the case

[1] This is now officially, if tacitly, conceded for the near future by the President's budget statement in January 1955, where it is pointed out that the "transition to the new basis for price supports will be gradual" and that the benefits will not, accordingly, be realized for several years. As a result, no early financial economies are foreseen as the result of smaller surpluses. (See *Budget Message of the President, The Budget of the United States Government for the Fiscal Year Ending June 30, 1956*. P. M. 59.)

of wheat, and there is some discomfort, the result may not be much more significant. In the commercial areas wheat supply is presumed to be inelastic because product substitution is at sharply increasing rates. This being so, there is no reason to think that the foreseeable price changes will much affect the supply. The weight of rational expectations would be to the contrary. More substantial adjustments might be expected outside the specialized wheat area, but relatively large shifts here would be required for a significant effect on total output.

Nor is there reason to expect that nominal or small changes in price—nothing for tobacco, a maximum of a cent or two for cotton—will have a perceptible effect on consumption. And again where the change is significant, as for wheat, there is the problem of elasticity. The foreseeable price changes for wheat will not visibly affect human use, and it is not clear that they will be large enough to stimulate use for feed. There has been a substantial element of faith behind the new farm program. Because it is "flexible," it is inherently salutary where surpluses are involved. It cannot be too strongly emphasized that faith without the requisite elasticities is not enough.

If the new program offers no cure for surpluses[2]—if it does not much affect these one way or another—it follows that the problem of controls also remains untouched and hence unsolved. If surpluses persist under the new program, administrators will still face the ineluctable choice between letting them grow still more, putting on moderate controls which might be ineffective, or putting on effective controls which (it will be feared) will put the administrators out of office. In any case, if the surpluses become tolerable it will be as the result of controls. Only in the case of corn, where we may already be close to equilibrium, is there a hope that we may escape both surplus accumulation and regimentation.

So after two years of notable effort, the significant past problems of our farm policy are all still with us. The farm program is still in conflict with the trade policy. There is still a severe, even indefensible, discrimination among different producers. The surplus problem is untouched. As a result, the need for controls remains and the dilemma they present is unresolved. Thus the conclusion that this is a uniquely discouraging moment in the evolution of our farm policy.

[2] This discussion takes as given the level of aggregate demand. If during the next crop year, crop conditions being given, we should have a strong, domestic demand coupled with a good export market for wheat and cotton, then the surpluses will fall. This will be true with the new system of supports; it would have been true under the old. If during the coming year unemployment grows, domestic demand becomes increasingly anemic, and foreign demand declines, then the surpluses will become more serious, whatever the level of support. The movement in demand, not the difference between flexible and rigid prices, will be of determining effect.

IV

There is a national supposition that we should always learn from our errors although, admittedly, this rule does not have much standing in matters of farm policy. Still, it is interesting, and we can hope that it may be worthwhile to reflect on the reasons why we tried so hard and accomplished so little. The first reason for the failure, oddly enough, was that no effort was made to correct the faults of the past programs. These were ignored. Instead, the new program was designed around a goal that was deemed good and desirable in itself. Because that goal seemed good, it was taken for granted that progress theretoward would solve all problems. There was never any reason to believe this, but it was believed nonetheless.

The goal was a nostalgic one—the traditional pricing arrangements of the free market. The notion that this market is the norm in economic policy is deeply imprinted on our minds. The layman finds it easy to make progress toward this goal the litmus test for economic wisdom. Even economists are not entirely immune to such easy judgements.[3] This test was liberally applied in writing the recent farm bill. The major motivation was the escape from the seeming artificiality of fixed or rigid prices for basic products. The goal was the seeming naturalness of prices that rose and fell with supply in the manner of the classical market. It was not possible to go all the way to the classical market for reasons that were economic as well as political. To have abandoned price supports for wheat, for example, would have caused an interesting political effervescence on the Great Plains. It would also have threatened a fall in farm income which not all opponents of price supports would have viewed with equanimity. Yet a step was being taken toward free prices. *Ipso facto* progress was being made in overcoming the faults of the past programs. There was never any basis for this belief. At any time during the past year a detached and scientific view of the new farm program would have shown that its remedial value was negligible.

That no such view was taken is hardly surprising. The tradition of economic analysis in the U.S.D.A. has long stressed a maximum of guidance by empirical data and a minimum of concessions to ideological nonsense. Attack on this work and the inconvenient truths it throws up has for a decade or more been a Washington political pastime. The new Administration made generous concessions to this evil viewpoint. In

[3] *Cf.* for example, *Turning the Searchlight on Farm Policy* (The Farm Foundation, 1952) and my commentary, "Economic Preconceptions and the Farm Policy," *American Economic Review* (March 1954). The Farm Foundation, in its recent and very interesting review of its first twenty years (*The Farm Foundation Story*, 1954) observes that the conclusions in *Searchlight* have had "wide acceptance." This could be so.

writing the new farm program it obviously regarded the judgments of social scientists as dispensable. It turned to its more tractable laymen and men of practical judgment. By an ironic coincidence, at the very moment it was making a historic miscalculation of supply and demand elasticities it was reorganizing the Bureau of Agricultural Economics out of existence.

The lesson is a costly one, but at least it has the virtue of being clear. Economics is central in the farm problem; economic analysis, however inconvenient, is indispensable in program reform. Progress will not come, except by the wildest accident, from the *ad hoc* brilliance of lay committees. The hope that such committees would "solve" the farm problem, a hope repeatedly articulated in 1953, was little short of childish. Nor is it to be supposed some great new idea—some brilliant exercise in social innovation—will suddenly eliminate our troubles. Natural science, for good or ill, allows of such break-throughs. Social science, because social innovation must be consistent with social institutions, does not. We can make progress in improving our farm policy, but the path will be marked out only by the objective, painstaking, and, above all, the professional use of economic knowledge. Now that there has been a demonstration of what happens when competent and responsible social science is insufficiently appreciated in program-making, economists are no longer under a compulsion to be modest.

V

There are some other lessons from the recent experience which seem worthwhile bearing in mind if future efforts are to be more rewarding. If we are to see progress not as an exercise in breath-taking reform but as the fruit of painstaking correction and improvement we must obviously learn to weigh the advantages of particular measures and programs. We must learn that an advantage here is likely to have an offsetting disadvantage elsewhere. The decisive question is whether there is a net advance.

Such an approach is sharply at variance with the present habit which is to assume that a program is wrong if a single serious disadvantage can be identified. Thus on the basis of its admitted faults the present program has been widely condemned as totally bad. It receives no credit for the efficient way in which it cushioned the decline in farm exports since 1951-52; a decline of truly mammoth proportions. The way in which it shielded the farmer in the 1953 recession and its contribution to general counter-cyclical stability in this period is ignored. It has received no credit for the social tensions it alleviated in the vulnerable farm areas simply because it alleviated these tensions. An assessment of pros and

cons is the most elementary of the techniques of sociometrics. It is curious that it is so rarely applied to farm policy.

Finally, the recent experience shows that in the future efforts to reform and improve the farm program must have a much more practical and definite orientation. If we are to make progress and if we are to be sure of making progress, we cannot organize our efforts around abstract goals. Free markets, uninhibited resource allocation, lessened reliance on price fixing, however much they excite our affection, are no more useful or appropriate goals than ninety per cent of parity. Work organized around such abstractions will turn out, as we have now learned, to be only sonorous boondoggling. Progress requires that we concentrate on finding specific remedies for specific faults in the present program. We must start by asking ourselves, simply and directly, what measures will solve the problem of surpluses, or controls, or discrimination, or trade, and at what price in the form of other disadvantages. There are some people, without much question, who implicitly or explicitly have identified reform of the farm program with its liquidation. An approach which runs in terms of problems and their correction will not be comforting to this viewpoint, for it implies that the program will continue. However, until farm policy is approached in simple, non-theological terms of problems and solution I doubt that we will make any progress. Let me illustrate this approach in relation to the shortcomings of the past programs which so unhappily continue under the Agricultural Act of 1954.

VI

It has long been obvious that much of our present trouble derives from the technique of support which we presently employ. This, of course, remains unchanged under the new legislation. The interference with foreign trade is the result of supports which prop prices above the world price. It is in the course of propping prices that the government acquires stocks. The technique of support, therefore, is the progenitor of the government-owned surpluses. Finally, the feasibility or impracticability of government storage helps determine whether or not there is a support program. Accordingly, the support technique has a bearing on the problem of discrimination.

This means that a change in the support technique—the abandonment of props and the substitution of a method that would allow prices to find their own level and provide direct payments to bring them up to the standard (i.e., 90, 82½, or whatever per cent of parity) would be a substantial reform. Since domestic prices would not be directly enhanced, the American exporter would be under no handicap and the domestic market would not be artificially attractive to the foreigner. The trade

problem would thus disappear. Also, discrimination between storables and perishables would no longer be technically necessary; obviously the prices of pork or butter or eggs can as readily be supplemented by direct payments as the price of wheat or corn. Since government loans or purchases are not used to peg prices, the surpluses do not become the property and hence the peculiar responsibility of the Secretary of Agriculture.[4]

Meanwhile, the protection accorded to the farmer would be substantially the same. The payments would compensate for adverse movements in his terms of trade in times of declining aggregate demand—the major rationale of the farm price program—and the economic stabilization effects of the present system are preserved and possibly enhanced.[5]

These are formidable gains. However, not all problems are solved, and these are not undiluted gains. The incentive to produce remains unchanged; presumably, therefore, production would be as large as before. Large production would manifest itself not in government purchases as before, but in low market prices and proportionately increased payments to give the farmer the guaranteed prices. In effect, the migraine induced by the surplus problem moves across the Mall from the office of the Secretary of Agriculture to that of the Secretary of the Treasury.

Since the surplus problem remains, so does that of controls. To keep costs down, undue expansion of unwanted crops would have to be prevented. There is a chance that the new technique of support would ease the control problem—for example, the supplementary payments could easily be denied to over-quota production. By thus enforcing a sharp reduction in marginal revenue, enforcement on the specific crop could be made relatively simple. However, simple or not, a detailed control apparatus is still necessary, and in cases of severe product disequilibrium it might still have to be unpleasantly harsh. I shall have a further word on this presently.

VII

There are some disadvantages from the remedy. Comprehensively viewed, the cost of the alternative technique is no higher and may be

[4] The proposals submitted to the Congress in the winter of 1949 that came to be known as the Brannan Plan were narrower in their application and hence in their effect. Storable products would still have been propped under the Brannan Plan; only perishables would have had supplementary payments. As a result, the Brannan proposals would not have much affected the trade problem—most export and import products are storable—and government accumulation of storable surpluses would still have been required. Mr. Brannan's attack was, essentially, confined to the problem of discrimination as well as to the handling of perishables like potatoes and butter where storage, though impossible or expensive, may nonetheless be forced by Congress.

[5] The cost of sustaining farm income is shifted from the consumer to the Treasury which, in times of receding aggregate demand, means a larger expansionist effect.

lower than the use of props. By directly boosting the price to the consumer, the present arrangement acts like a sales tax levied on the particular product. The consumer pays this tax. Under the alternative system the money would in fact be raised by the Treasury. When the price supplements were being paid as the result of a shortage of aggregate demand (i.e., a developing depression), this would involve no embarrassment, for it would be fiscally desirable to allow the payments to increase the deficit. With demand at full employment levels, funds for any payments that might then be required should, in principle, come from taxes. This is unlikely to be palatable to Treasury and Budget authorities, although their preferences should never be decisive.

There is also the possibility that farmers—some at least—will find the revised technique less palatable, although Hathaway's investigations in Michigan as well as polls by *Wallaces' Farmer* and *Iowa Homestead* and the *Wisconsin Agriculturist*[6] suggest that this resistance is easily exaggerated. Under the revised technique, what the farmer regards—in my view with justice—as legitimate protection in light of his peculiarly vulnerable position takes the form of a wholly overt subsidy. In the Puritan ethos there is no such thing as a legitimate subsidy. If one must nonetheless be subsidized, how much more seemly to have it out of sight.

Under the revised technique the position of large farmers is also less happy. The present technique of propping prices means that prices are propped equally for all. There can be no discrimination against the larger farmer. The amount by which he benefits from the program cannot readily be calculated. The justification for a program is that the uninhibited price system treats the farmer with rather more rigor than it does other groups; that it exposes him to especially adverse movements in his terms of trade when aggregate demand falls; and that both farm and general welfare are served by mitigating these effects. If this be so, then the effects should be mitigated for large farmers as well as small. It may be sound policy to discourage big farms. This, however, should be a separate decision to be handled, presumably, in separate legislation. Still, it is improbable that the larger farmers, who will on occasion be recipients of large checks, will ever be as comfortable under the revised technique as under the present one.

Some of these defects of the revised technique could be overcome by

[6] Dale E. Hathaway, E. E. Peterson, and Lawrence Witt, *Michigan Farmers and the Price Support Program II. Farmers' Attitudes Toward the Support Program*, Technical Bulletin 235. East Lansing: Michigan State College Agricultural Experiment Station, December 1952. In its August 7 issue, the *Wisconsin Agriculturist* reported that of farmers favoring supports for dairy products, 26 per cent favored purchase as at present and 45 per cent favored use of supplementary payments. The rest had no opinion or were undecided.

effort again addressed specifically to finding solutions. The high budget cost could be offest or partially offset by converting the program into a quasi-insurance system under which premiums would be collected when prices were above standard levels.[7] It should not be assumed that this would be outrageously unpopular. Farmers might approve. Payments to farmers could be made not by government check, but, in a more becoming manner, by way of buyers or processors and so added to the price. Large farmers might be reassured if the intention to divorce the payments from discrimination on farm size were strongly affirmed by Congress.

VIII

As noted, the problem of surplus *cum* controls remains. However, were it once tackled, not as an exercise in social theory or an operation in political semantics, but as a problem to be solved, it might be found rather simple.

At the outset a distinction must be made between surpluses that are associated with a general deficiency in demand and those that are the result of a particular disequilibrium in a product or group of products. It is not too much to say that farm price policy can be discussed intelligently only in light of this distinction. In the past it has not often been made. Let me speak first of the general equilibrium surplus.

When aggregate demand in the economy falls we may expect an all-round redundancy of agricultural output precisely as we expect general unemployment of workers. Unlike unemployment, the concept of an agricultural surplus is not without ambiguity. It implies that more product is available than can be sold at prices the community regards as adequate. Obviously, the notion of what is adequate involves some highly subjective judgments. However, the fact that agriculture in the short run adjusts to declining demand with falling prices, and industry with a curtailment of output, means that the low prices (or growing government inventories) are the precise counterpart of unemployment in industry. The obvious long-run remedy for this type of surplus—and very likely the only possible remedy—is to repair the shortage of aggregate demand. The very tasks which this shortage of demand causes the government to perform in the agricultural sector—the acquisition of stocks to support prices or the outlay of funds to supplement prices under the alternative arrangement here suggested—help to remedy the deficiency in demand. We should accept and even welcome these outlays as part of the counter-deflationary machinery of the modern economy. In principle, no measures of crop curtailment or control should be taken when general equilibrium

[7] Geoffrey Shepherd, "A Farm Income Stabilization Program Could be Self-Financing," *This Journal*, February 1948.

surpluses appear. The practical situation may conceivably force exceptions but, as a broad rule, when farm surpluses are the result of a depression, broadly defined, the line of remedy runs to the depression and not to the surpluses. The question presented by the surpluses is how to live with them as gracefully as possible. Clearly the alternative support techniques here outlined, which keep them from accumulating in government storage, will substantially ease this problem of surplus management especially for perishables.

The particular equilibrium surplus may arise even when the economy is functioning at full-employment levels. Exceptionally high yields and production or a decline in foreign or domestic demand, or some other cause peculiar to one or a group of products, brings a greater production than can be sold at prices that are deemed adequate. This is the nature of the present surplus of cotton and wheat and of a limited number of other items. In the case of cotton, the cause is the high upward elasticity of supply. In the case of wheat it is the decline in overseas demand following the earlier expansion to meet wartime requirements.

The particular equilibrium surplus exists because the price standard is too high. It follows that it could be eliminated by lowering the standard. There is obviously no universally defensible price standard. In the current case of wheat, levels by some standards of equity may well be "too high." Technological change has left the wheat parity marooned on a very high shoal. But as a device for surplus control, price reduction appeals more to those whose affection for the traditional outweighs their desire to be practical. It is most ardently defended by those who dislike on grounds of principle to see the farmer escape the punishment that the market is supposed to mete out to those who produce too much. Unhappily, where the problem of the particular equilibrium surplus is worst —in the case of wheat and cotton in particular—the elasticity of supply in response to price reduction is almost certainly rather low. To be effective the price change would have to be punishingly severe. Such punishment does not commend itself to farmers or to many other people. There is, one need hardly add, a related question of votes.

The solution of the particular equilibrium surplus is not to attack cereals or cotton directly, which will accomplish little or nothing, but to put on a truly vigorous drive to shift resources to the livestock economy. In this effort we are jointly blessed by the much greater elasticity of the demand for animal products as compared particularly with cereals and their very much greater resource requirement per unit of nutrients provided to the consumer. Hence, in sharp contrast with wheat, a small decrease in the price of livestock products will bring a relatively large increase in consumption. And to get the equivalent calories in the form of animal prod-

ucts means a much more than proportional decrease in cereal production. It takes, we know, several times more acres to provide a person with a meat diet than a cereal diet.

However, to remedy the surplus in this way will require a strong reversal of present policy. The present policy favors the surplus products over those which offer the promise of remedying the surplus. Wheat, cotton, and other surplus products are produced with the advantage of a firm price guarantee. Animal products either enjoy no such guarantee or, as in the case of dairy products, the guarantee is substantially lower. A visitor from Mars with a perceptive approach to economics would conclude from present arrangements that we cherished our over-production and our controls and sought for nothing so ardently as to keep the CCC in business. A revision in the technique of support is essential for an attack of the particular equilibrium surplus since the present method cannot be applied to meats and has grave disadvantages for dairy products.

But merely to eliminate the present discrimination against animal products is almost certainly not enough. A determined program for eliminating surpluses would go farther and place a positive premium on animal products. By supplementary payments, dairy and poultry products, pork and (if the cattlemen could be persuaded to go along) beef would be made profitable to the producer and attractive in price to consumers. Every market incentive would then exist for a movement of resources from the sector where they are an embarrassment to the sector where they can be accommodated with comparative ease. A small subsidy of livestock products would, in effect, be used to eliminate the need for a much larger and much less useful one for cereals. With the surplus would go the controls.

However, a full-scale attack on the surplus and control problem would not rely exclusively on market incentives, however generous. Direct resource transfer payments would be offered to farmers who shift land from wheat to permanent pasture and perhaps particularly from cotton to balanced-farming systems. (These incentives should also be used for less important crops like apples and prunes which, otherwise, we subsidize year after year.) Also, the government credit agencies should be awakened to provide special credit up to a very large percentage of total requirements of farmers making the favored resource shifts.

IX

The measures here outlined would not "solve" all of the farm problem —or more precisely all of the commercial farm price problem. There are disorders on which I have not touched; no doubt we would be blessed

with some new problems before the old ones disappeared. Yet it is evident that the worst of the present problems would yield if vigorously attacked. Substantial results could reasonably be expected in as little as five years. Moreover, the required measures do not subject the farmer to the unreality of more extreme punishment by the market than he now experiences. Nor need the cost be great. Given full employment, the end product of the measures here outlined might well be a direct Treasury cost as low or lower than at present. Nor must we accustom ourselves to any breath-taking innovations in economic or social policy.

We have come to assume that the farm problem is unsolvable. To suppose that something might be done is to be thought naive, and this defeatism will be all but universal as the extent of the recent failure comes to be generally appreciated. In fact, the problem may not be especially intractable. It hasn't been solved because it hasn't yet been attacked.

WHAT CAN A RESEARCH MAN DO IN AGRICULTURAL PRICE POLICY?*

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WHAT are the objectives of price policy research, and how can research in this field be conducted most effectively?

This is an important question. Billions of dollars are involved in agricultural price programs, and the subject is so explosive that more than one state experiment station director has refused to handle it, on the grounds that it might incinerate him.

It seems to me that the objectives and procedures involved in agricultural price policy research can be most clearly set forth by comparing them with the objectives and procedures in a related field, agricultural price analysis.

The objective of research in the field of price analysis is comparatively simple. Research in price analysis deals with the kind of question a child might ask about a bug—what makes it move? The objective in price analysis is to explain why prices move; it is to ascertain the factors that *cause* price variations, and to measure in quantitative terms the relations between these factors and the variations in prices. A further objective in some cases may be to ascertain and measure the *effects* of these price changes on income, production, consumption, etc.[1] The procedures usually applied are simple and multiple graphic and mathematical correlation, simultaneous equations, etc., guided by economic theory and a knowledge of the characteristics of the commodities whose prices are being analyzed.

Objective of Research in Agricultural Price Policy

Many would say that the objective of research in agricultural price *policy* is much the same as the objective of research in price analysis. They would say that the objective of agricultural price policy is simply to measure the effects of specific price programs that have been set up to implement specific price policies. This objective is implicit in the titles of

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† I am indepted to my colleagues John Nordin and Earl Heady for constructive critical comments.

[1] This is what is done for example in Karl Fox, "Factors Affecting Farm Income, Farm Prices, and Food Consumption," *Agricultural Economics Research,* BAE, USDA, Vol. III, No. 3, July 1951, pp. 65-81.

two major publications in the field of agricultural price policy that have appeared in recent years.[2] On the face of it, this objective is merely a specialized branch or extension of the "further objective" of price analysis given in the preceding section (to measure the effects of prices on income distribution, production, consumption, etc.) to the measurement of the effects of a price *program* on these things.

But inspection reveals the fact that right in the two publications cited, the authors go farther than the titles alone imply. One of the later sections in Johnson's bulletin is headed "Evaluation of Existing Control Programs Must Be Based on Beliefs and Convictions"; another is headed "Various Beliefs Which Have Determined how Programs Were Operated and Benefits Distributed," and another is headed "Present Program Could be Modified to Eliminate Certain Administrative Difficulties, Pass Gains in Efficiency on to Consumers and Retain Stability Features." Thus the study goes on to consider evaluation and modifications of the program. Similarly one of the later sections of Gray et al. is headed "Appraisal of market restrictions as a method of increasing producers' incomes," and another, "Policy Proposal." Most of the books on agricultural price policy similarly include appraisals and new proposals. Some authors have gotten into trouble by recommending programs that differed from the programs advocated by farm organizations in their states.[3] This is the sort of thing that gives experiment station directors the willies, and keeps the USDA out of agricultural price policy research entirely.

On the basis of some experience and observation in the field, I believe that the best solution for this problem is not merely to try to "keep out of trouble" by keeping out of appraisals and proposals, but rather to do the job including appraisals and proposals, in the light of a clarification of the objectives and procedures in price policy research which is attempted below. I do not offer this as a means for pussy-footing; quite the contrary. I offer it as a means for doing the job in good objective scientific style, so that nobody has to do any pussy-footing.

Objectives and Procedures

A suggested set of objectives and procedures for effective price policy research is outlined below:

[2] Glenn L. Johnson, ***Burley Tobacco Control Programs,*** Bulletin 580, February, 1952, Kentucky Agricultural Experiment Station. Roger W. Gray, Vernon L. Sorenson, and Willard W. Cochrane, ***An Economic Analysis of The Impact of Government Programs on the Potato Industry of the United States,*** Minnesota Agricultural Experiment Station, Technical Bulletin 211, June 1954, North Central Regional Publication No. 42.

[3] A recent example is Clyde Mitchell's run-in with the leading farm organization in Nebraska, reported on the editorial page of the *Des Moines Register,* October 4, 1954.

1. *Outline the Price Problem*

The first step in price policy research is to start out with a statement of the "problematic situation"—the variability of prices or income, the level of prices or income, etc., or whatever it may have been—that caused the particular price policy to be developed in the first place. This step is comparatively simple.

2. *Ascertain the Objectives of the Price Policy*

The next step is to ascertain what the objectives of the price policy are. This does not mean stating what the research man thinks the objectives should have been or should be now. It means stating what the framers of the policy had in mind, entirely independent of what the research man thinks they should have had in mind, and entirely independent of what the research man thinks the objective should have been.

This distinction between the objectives in the minds of those who framed the price policy and the objectives in the mind of the research worker is not always clearly recognized by the research worker himself. It was not clearly recognized by the North Central Regional Research Committee on agricultural price policy in 1953 when they were asked to appraise the "Summaries and Suggestions Received" by the Secretary of Agriculture on agricultural price policy. Some of the members were not sure whether their job as research members included appraising price policy. Those who were willing to appraise price policy agreed that before they could proceed to appraise, they needed a statement of the objectives of the price policy, so that they could measure performance against intention. Accordingly, they drew up a statement of the objectives of agricultural price policy, and promptly fell into disagreement about it. They disagreed over the goals of price policy, and they disagreed over the question whether or not agricultural economists should be making statements as to objectives in the first place.

Here is part of the statement of objectives that was drawn up at that time:

"We believe that it is essential that a statement of basic objectives precede and condition the selection of programs and methods to be used in implementing agricultural policy."

"Furthermore, the programs selected should be appropriate to these objectives and consistent with more general economic policies of the government, such as monetary and fiscal policy and foreign trade policy."

"Our price policy should be such as not to destroy nor seriously interfere with the functions of prices as means of directing production and consumption. It should enhance the effectiveness of prices in performing these functions."

It seems clear to me now, although it was not clear then, that we were arguing about the wrong set of objectives. We were arguing about *our* objectives for agricultural price policy—what we thought the objectives should be—when what we should have been doing at that stage was to argue about what the objectives were in the minds of those who framed the policy and set up programs to carry it out. When we appraise a plow, we do not condemn it because it cannot fly. We appraise it with reference to how it does the job it was designed to do—to turn over the sod and bury the trash. If we find that burying the trash leaves fields susceptible to soil blowing, we would not condemn the plow. We would instead point out to farmers that if they want to retard soil blowing—if that is their objective (note: not if that is *our* objective) then a one-way is a better implement for them than a plow. If they do not want to retard soil blowing, or if their soil does not blow in the first place, then the plow is the best implement. But the decision depends on the farmers' objectives, not on ours.

It is not easy in all cases to determine just what the objectives were in the minds of those who framed a price policy. Even when public statements were made when the policy was set, those statements are not always clear nor always free of playing to the gallery. Henry Wallace's statement of the purposes of the CCC in 1936 is clearer than most:

"By the ever-normal granary I mean a definite system whereby supplies following years of drought or other great calamity would be large enough to take care of the consumer, but under which the farmer would not be unduly penalized in years of favorable weather. During the past seven years, weather, prices, and supplies have swung so violently from one extreme to the other that it is time for all thoughtful men and women, whether living on the farm or in town, to consider what action may be taken to promote greater stability."[4]

This statement was followed a few years later by a more specific pronouncement. It referred to the three "fundamental functions of the CCC loan program: Namely, to protect and increase farm prices, to stabilize farm prices, and to assure adequate supplies of farm products."[5] The hearings usually conducted before legislation is passed, and sometimes the statement of the objective in the law itself, are sometimes useful. An economic historian may provide useful interpretations.

In some cases, the objectives that are stated are not the real or primary objectives. The stated objectives of the original ever-normal granary were the stabilization of supplies and prices. There is good reason, however, to believe that the primary objective was rather to raise farm prices and

[4] *The Agricultural Situation*, BAE, USDA, Vol. 20, No. 4, January 7, 1936.
[5] *Report of the President of the Commodity Credit Corporation*, 1940, p. 4.

thus increase farm income—to "stabilize them upward." But there would be opposition from consumers to this objective, whereas everybody is in favor of stabilization. Not until 1940 was the price-raising objective spelled out loud in the CCC quotation given above. In cases like these, the original statement alone does not tell the whole story. Judgment is needed here to determine what the objective really was. But it is the research man's judgment about what people had in mind, not his judgment about what he believes the objectives ought to be.

3. *Compare Performance With Objectives*

After the original objectives are set forth, the next job is to measure the effects of the program and compare them with the objectives. This is a big job, and a complicated one. Its purpose is to show whether the programs attained their objectives, at what cost. Did the corn loan program stabilize corn supplies and prices and livestock production and prices? If so, to what degree, and at what cost? This is strictly a job of statistical measurement.

4. *Estimate the Effects of Modifications of the Program*

The next step is more difficult. It is to estimate, not what the effects of the programs were, but what the effects of specified modifications of the programs, or even entirely different programs, *would have been* if they had been put into effect. What would have happened if the CCC had used more flexible loan rates? If it had used outright purchases and sales, instead of loans? If it had done this or that other thing? This step could also include projecting estimates of this sort into the future.

5. *Estimate the Effects of Alternate Policy Objectives*

The final step is to estimate what the effects of specified alternative *policies* would have been, and would be in the future. What would have happened if different policy objectives had been adopted—if stabilization about world price levels rather than about parity levels had been the goal, or if raising the long time level of prices, or of income, to meet monopoly in other parts of the economy, had been chosen?

This is the most difficult step of all, and the one that has been most likely to get the investigator into political trouble. It seems to me, however, that the investigator does not need to stay out of this sort of work on that account, nor does he need to get into political difficulties when he goes in.

What he does need to do is to handle this job as scientists handle all their scientific jobs, as scientists, not as salesmen.

It is not our job as agricultural economists to say what the objectives

of agricultural price policy *should be*. It is not our job to set up *our* objectives of agricultural price policy. It is not our job to say that we think that the objective of agricultural price policy ought to be high rigid prices or low flexible prices or some other prices.

When I hire a heating engineer, I do not hire him to tell me what kind of a heating system he thinks I ought to have. I hire him to tell me the various features and costs of different heating system, so that I can make up my own mind according to whether or not I have cold feet or sensitive ears or a large or small pocketbook.

As agricultural economists, as scientists in a democracy, our job is not to tell people what we think they ought to do. A physicist does not tell us we ought to use uranium-235 to cause an explosion. He tells us that if we use that element under very special conditions we will cause an explosion; if we use something else, we will get some other result. Then he leaves it up to the military, and ultimately to the people of the United States, to decide what result we want to get.

Similarly, as agricultural economists, our job is to show impartially what the effects of high rigid prices would be and what the effects of low flexible prices would be. If the voters decide that they want the one, it is not for us to say that they should want the other.

They may be wrong. If so, our job is not to try to convince them that our views are correct as such. Our job is to educate them in the true sense of the word (not in the propaganda sense) until they see the economics of the matter more clearly and make the correct judgment themselves. They do not want our opinions as to what they ought to do. They want our technical estimate of what will happen if they do this, and what will happen if we do that.

Thus when farmers ask us at the end of a discussion meeting "what do you think? Are we barking up the wrong tree in trying to get parity prices?" they do not really want to know what we think. And we do not reply that we think this or that. For when farmers ask a nutritionist what he thinks about antibiotics, they do not really want to know what he thinks. They are not interested in his mental processes. Instead, they want to know what the facts are—what effects antibiotics would have on their livestock. The nutritionist does not tell them what he thinks. Like any scientist, he takes himself out of the picture. He does not say "I think this or that." He says "The facts show this or that." He simply tells farmers what the facts are that his experiments have revealed, and leaves them to make up their own minds about whether or not to use antibiotics, in the light of the facts, not in the light of his opinions.

Similarly, we do not reply to farmers that we think this or that about parity prices. We ask them "What is it you want to accomplish? What is

the goal you want to reach?" and we show in as factual a manner as our analyses and data permit what will happen under parity prices or some other prices implemented by loans or other means. We show them how good the means are for attaining the ends they seek.

We go further. We ask them whether or not the ends they seek are consistent with the ends sought by society as a whole. If they are, well and good. If they are not, it is our job to point that out. But it is not our job to tell farmers that they shouldn't try to attain those ends. In a democracy, the voters will tell them that, not the technicians.

A More Productive Approach in Price Policy Research

What is involved here, I believe, is nothing less than the whole fundamental approach to economic analysis.

One approach is well represented in the recent writings of two of my good colleagues:

"We economists are almost all honest men; we are all sincere in our quest for roughly the same goals (adequate production, decent farm income, and maximum possible individual freedom); why then do we arrive at such widely different recommendations? A main reason is that we start with completely different assumptions as to the nature of man and society. So we inevitably arrive at different 'answers.' "[6]

That is to say: In economics, the answers you arrive at depend upon the assumptions you start out with. Different economists—different answers.

This bothers me. If it were true, it would raise a question whether economics is a science or not. For one of the characteristics of a science is that the answers depend on the facts, not on the investigator's beliefs. Different investigators get the same answer.

Another colleague starts out to deal with land tenure problems[7] by outlining what he calls two different theories of land tenure, the "*family farm theory of tenure*" and the "*farm business theory of tenure.*" These two theories place different emphasis upon various aspects of farm tenure, and lead to conflicting conclusions with respect to certain specific tenure conditions.

He presents these two theories in turn, starting out in both cases with the same paragraph: "This theory consists of the following general propositions. The welfare of the nation and of the rural community is best served if:"

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[6] C. Clyde Mitchell, "Parity Price Supports and Controlled Inflation," *Farm Policy Forum*, June 1953, p. 21.

[7] Rainer Schickele, "Theories Concerning Land Tenure," *This Journal*, XXXIV:5, December 1952, pp. 734-43.

Then come the general propositions. Under the family farm theory, these propositions are, for instance. (. . . welfare . . . is best served if:) "Farmers own and operate their farms as independent entrepreneurs. Farm units are not larger than the farmer and his family can operate without depending upon a substantial year-round hired labor force," etc.

These general propositions contrast with those that make up the farm business theory of tenure: (. . . welfare . . . is best served if:) "free market forces are allowed to determine the tenure status, size of farm, and family income for each farmer," etc.

Schickele points out the essential difference between the two theories. The family farm theory stresses the distributive equity, social status, and security aspects of community welfare, while the farm business theory emphasizes the production efficiency aspects of economic welfare.

Up to this point, one might merely raise a question concerning Schickele's use of the word "theory." A theory is an explanation of phenomena, confirmed by factual evidence. What Schickele calls theories, Mitchell calls assumptions; I would call them preconceptions. Schickele then goes on to say that a scientist regards any theoretical proposition as a hypothesis constantly subject to test for verification, modification, or abandonment. But then he adds "But the ideologies out of which theories are conceived are not amenable to such empirical testing. They are believed or disbelieved. A theory can only be tested in terms of its own conceptual structure. . . . Beliefs cannot be verified objectively. . . . The empirical outcome of the struggle between conflicting beliefs is determined primarily by the socio-political order of society, by the relative power positions of the respective groups. Whether actual events in American agriculture will move in the direction of the family farm or the farm business tenure theory will depend largely upon the relative power of the two groups holding these conflicting beliefs, in the formulation of public policy affecting tenure."

Willard Cochrane supports Schickele's approach. He says flatly, "All research is conducted on premises." And further, "I agree with Clyde that you cannot test preconceptions or assumptions and different analyses and conclusions. Premises, preconceptions or assumptions take two forms: (A) beliefs about the facts, or more probably beliefs about relationships existing among facts; and (B) beliefs about justice, equity or what is good. You can't test (B) and you assume (A) for the reason that given the present state of knowledge you can't know (A)."[8]

These things are said in all honesty of conviction, but they seem to me to divert intellectual inquiry into a blind alley.

Philosophers have a name for this approach. They call it rationalism. It

[8] Letter to the author, October 21, 1954.

does not have a very high rating among scientists and philosophers.

"The fourth unacceptable way of seeking knowledge" (the other three were revelation, authority, and intuition) "is that of traditional rationalism, which, basing itself at the start on certain fundamental mathematical or logical assumptions, builds up from them through rigorous deduction a closely interrelated complex of ideas into a coherent whole. Rationalism ... has grave shortcomings in that it submits neither the original propositions, which may be selected through intuition, nor the final conclusions, to experimental verification."[9]

It seems to me that this traditional rationalism approach is completely unscientific. It is more likely to end up in disaster than in any addition to scientific knowledge. If I start from an assumption that there is no such thing as gravity, and step out of my window, I will soon learn the folly of that approach. Is it not better for scientists to start with observed facts, such as that most objects fall to the ground, and go on from there to measure the rate of fall and to discover the reasons why some objects do not fall–unbiased by any assumptions to predetermine their answers?

Start With A Problem, Not With An Unverifiable Belief

Instead of starting from assumptions, as Mitchell does, and as Schickele does when he starts from beliefs that cannot be verified objectively, and as the ancient astronomers did when they said "Seven is a magic number, therefore there must be seven planets," is it not more scientific to start without any propositions about the planets, but simply count them?

Rather than say that "Beliefs cannot be verified objectively" I would say the opposite. Myrdal states unequivocally "A person's beliefs ... can be objectively judged to be true or false and more or less complete."[10] I would say that the essence of scientific inquiry is to test (verify or disprove) beliefs.[11] Galileo did not say, "Everybody believes that the earth is fixed and that the sun revolves around it. Beliefs cannot be verified or disproved objectively. I can only observe objectively what beliefs are held by what groups, and leave the motion of the earth to be decided by the relative power of the different groups." He proceeded instead to construct hypotheses and test them without regard to whether they were generally believed or not. It is true that when he published his conclu-

[9] Corliss Lamont, *Humanism as a Philosophy*, Philosophical Library, 1949, pp. 2345.

[10] Gunnar Myrdal, *An American Dilemma*, Harper and Brothers, 1944, Appendix 1, p. 1027.

[11] "A legitimate task of education is to attempt to correct popular beliefs by subjecting them to rigorous examination in the light of the factual evidence" (Myrdal, *op. cit.*, p. 1031).

sions, which conflicted with popular belief at the time, he got into trouble. But his views were scientifically correct, and eventually they changed popular beliefs.

The approach outlined in Schickele's paper starts from the wrong point of departure. It makes me feel like the Kentucky mountaineer, trying to tell a passing stranger how to get to Smithville, and ending up finally by saying "If I wanted to get to Smithville, I wouldn't start from here."

Research on any subject, it seems to me, should begin not with unprovable premises or assumptions or propositions but with a problem. Then it should set up alternative hypotheses (tentative solutions to the problem) and proceed to get the data that will test the hypotheses.

"Thinking begins in what may fairly enough be called a "forked-road" situation, a situation which is ambiguous, which presents a dilemma, which proposes alternatives."[12]

"Thinking begins not with premises, but with difficulties; and it concludes not with a certainty but with an hypothesis that can be made "true" only by the pragmatic sanction of experiment . . . our social ills are to be handled no longer with majestic abstractions like individualism and socialism, competition and cooperation, dictatorship and democracy, but with restricted inquiries, specific analysis, careful formulation, patient experimentation, and piecemeal renovation."[13]

Thus research in land tenure should start out, not with propositions that welfare is or is not best served by family-sized farms, but with specific and limited problems, such as: What is the most efficient (lowest cost) size of wheat, livestock, etc., farm (the answer would be different for each commodity, and for each major climatic division). And what are the sociological benefits of family-sized farms and of different forms of land tenure?

Similarly, research in agricultural price policy would not start out with a proposition that welfare is or is not best served by free market prices, but with an inquiry into the different results of different programs and policies. When these results have been determined and presented as clearly as possible, the voters can judge intelligently how much of each end (efficiency, security, etc.) they want, according to their systems of values.

Most scientists take the position that this is as far as a scientist can go. I have some questions to raise about this position, but that is another story.

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[12] John Dewey, *How We Think*, D. C. Heath & Co., 1910, p. 11. See also Dewey's *The Theory of Inquiry*, Holt, 1949, pp. 107-8.

[13] From article on John Dewey, *Encyclopedia Britannica*, Vol. 7, 1946, p. 297.

PERCENTAGE DEPLETION: A CONSIDERATION OF ITS APPLICABILITY TO INCOME FROM FARMING

BENNETT FINLER

I. *Introduction*

THE agrarian revolution that took place in Western Europe during the Middle Ages freed the serfs from the land to which they had been bound. According to the historians, at the same time as it freed the serfs from the land, it also freed the land from the serfs, many of whom were thus left landless to shift for themselves.

In viewing the present situation in the United States, if it was suggested that current proposals, purporting to free the farmer from "regimentation" by government, might also be intended to free the government from the farmer, the analogy might be considered somewhat farfetched. There is considerable difference of opinion, both as to the extent to which the farmers have yielded up their freedom of enterprise to government supervision; and as to the extent—if any—to which the government has, over the past twenty years, subserved the interests of the farmers to the disadvantage of other economic groups. Specifically, the controversy has recently centered about the forms of government support to farm income, questioning their cost, their consequences and their replaceability. In any case, there is little doubt that if proposals to revise the present forms of government aid to the farmers are to enlist the support of the farmers themselves, they should be so designed as to enable the farmer to obtain or retain a position as a relatively equal partner of other forms of business enterprise in the economy.

In a recent article, Professor Galbraith posited the duty of economists "to discover and explain the consequences of given economic actions."[1] In the same article he called attention to what he considered "the remarkable divergence between scientific prescription and practical farm policy." Although Professor Galbraith was referring to his professional colleagues, a similar criticism might perhaps be applied to those farmers and their spokesmen who object to submission of their policies to the tests of scientific analysis. For example, one farm leader has objected to the statement that agricultural price supports constitute a means for "redistribution of national income," while almost in the same breath he made a plea for raising the proportion of farmers' income to total national income.

No doubt the bridge between scientific prescription and practical farm policy will be a long time building. The purpose of this contribution to the subject is to suggest one approach to the bridge.

[1] J. K. Galbraith, "Economic Preconceptions and the Farm Policy," *American Economic Review*, Vol. XLIV, No. 1, March 1954, p. 52.

II. *The Depletion Provision: History and Definition*

It is a source of surprise to this observer that no serious effort seems to have been made to utilize a formula that is not only already written into national legislation but has gradually been extended in its application to a whole segment of our economy. The formula is called percentage depletion.

First adopted in the Revenue Act of 1926 for oil and gas wells, in the 1932 Act the provision was extended to coal, metal and sulfur mines. In spite of the objections of many economists and government officials Congress has expanded, rather than reduced, the coverage of the percentage depletion provision. The new Internal Revenue Code of 1954, approved August 16, 1954, makes the most liberal provisions to date. The relevant clauses are as follows:[2]

"Section 613. Percentage depletion.

"(a) General rule.—In the case of the mines, wells, and other natural deposits listed in subsection (b), the allowance for depletion shall be the percentage, specified in subsection (b), of the gross income from the property . . . [and] shall not exceed 50 percent of the taxpayer's taxable income from the property . . .

"(b) Percentage depletion rates . . .

[The following clauses numbered (1) through (5) list the specific rates for oil and gas wells, sulfur, uranium, etc.]

(6) 15 percent—*all other minerals*[3] . . . For purposes of this paragraph, the term 'all other minerals' does not include—

(A) soil, sod, dirt, turf, water, or mosses; or

(B) minerals from sea water, the air, or similar inexhaustible sources.

"(c) Definition of gross income from property.—

(1) . . . The term 'gross income from the property' means, in the case of a property other than an oil or gas well, the income from mining.

(2) . . . The term 'mining' includes not merely the extraction of ores or minerals from the ground but also the ordinary treatment processes normally applied . . .

(3) . . . The term 'extraction of the ores or minerals from the ground' includes the extraction . . . of ores or minerals from the waste or residue of prior mining . . ."

The sections of the new Internal Revenue Code relating to percentage depletion now extend *blanket coverage to minerals in general,* departing from the previous policy of an enumerated list of the specific minerals covered. The new law broadens both the coverage and the definitions of activities entitled to use percentage depletion.[4]

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[2] United States Code, Congressional and Administrative News, 83d Congress, 2d Session, Internal Revenue Code of 1954, pp. 242-243.

[3] Emphasis added by the writer.

[4] The detailed discussion and testimony preliminary to passage of the Act are contained in the following: *Hearings* before the Committee on Ways and Means, House of

One relevant example of the testimony presented in the hearings on the Code is as follows:

"We are in accord with the plan of the bill to include a blanket provision extending percentage depletion to minerals in general."[5]

The special claim which these industries have to this special treatment in the Internal Revenue Code is subsumed under the general heading of "extractive" industries, specifically, those deriving their income from "wasting assets." The principle involved is that the revenue from these enterprises is not a true income, as the *yield* on the capital investment, but rather a return of the *capital itself*.[6]

The specific provisions, regarding the basis against which to charge depletion, went through three stages: first, asset cost, then discovery value, and finally percentage depletion as a percent of gross income. The Revenue Act of 1913, which initiated federal income tax legislation in the United States, allowed all extractive enterprise to charge depletion on the basis of cost. Then the Revenue Act of 1918 liberalized the basis by permitting the use of the "discovery value" basis for depletion.[7] As a result, "to the unsolved problem of what the annual [depletion] rate should be, this added an unsolvable problem of what the total amount to be recovered over the years should be."[8]

Both the "unsolved problem" and the "unsolvable problem" were disposed of (throwing out both the baby and the bathwater) by the new "percentage depletion" method provided in the Revenue Act of 1926, which is described as follows:

"Percentage depletion means that a stipulated percentage of gross income

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Representatives, 83d Congress, 1st Session, in four parts, plus Subject Index with List of Witnesses and Organizations, 2,950 pages; *Report* of the Committee on Ways and Means, House of Representatives, to accompany H. R. 8300, A Bill to Revise the Internal Revenue Laws of the United States, House Report No. 1337; *Hearings* before the Committee on Finance, United States Senate, 83d Congress, 2d Session, in four parts, 2,443 pages; *Report* of the Committee on Finance, United States Senate, to accompany H. R. 8300, Report No. 1622; and the Conference Report, United States Code, Vol. 14, p. 4241 (1954 edition).

[5] Statement of Henry B. Fernald, Chairman, Tax Committee, American Mining Congress; *Hearings* before the Committee on Finance, United States Senate, 83d Congress, 2nd Session, on H. R. 8300, Part 3, April 1954, pp. 1241-1242.

[6] "Depletion deductions are made on the theory that they represent a return of capital." Roswell Magill, *Taxable Income*, (New York: The Ronald Press Co., 1936), p. 317.

[7] "Discovery value permitted the cost basis for depletion to be increased to the fair market value on the date of discovery or within 30 days thereafter, when and if such fair market value was materially disproportionate to the cost. Such discovery value might of course be many times the actual cost of the property." D. T. Smith and J. K. Butters, *Taxable and Business Income* (New York: National Bureau of Economic Research, 1949), p. 84.

[8] *Ibid.*

is allowed as a deduction without any reference to original cost, adjusted cost, or discovery value. For industries authorized to use percentage depletion, discovery value was in fact dropped as an alternative basis for depletion and has now become of negligible importance."[9, 10]

Traditionally, depletion is an accounting procedure for writing off the cost of a "wasting asset" over the estimated life of the asset. There are, allegedly, two essential characteristics of "wasting assets": in each case the physical asset is due ultimately to be exhausted, and it cannot be replaced.[11]

A strict application of these two criteria to the various types of "wasting assets" would leave serious doubt as to the validity of the justification for percentage depletion—on these counts, at any rate. Professor Carlisle has pointed out that, on the one hand, estimates of the magnitude of the "wasting asset" are subject to a wide margin of understatement. For example, he reports that the Climax Molybdenum mine's early estimate of proved plus probable ore reserves, of 100,000 tons, was replaced by a subsequent estimate of 100,000,000 tons (an error of 1,000 times!). By 1940, 43,000,000 tons had actually been mined.[12]

On the other hand, the limit of extraction is not so much the physical exhaustion of the deposit, as the marginal rate of return. In respect to coal, for example, Carlisle states that "there is a wide range of choice as to the

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[9] *Ibid.*, p. 85.

[10] The abandonment of discovery value as a basis for charging depletion is noted in the Senate report, discussing Section 613 (b): "The classification of non-metallic minerals into these broad all-inclusive groups makes it possible to eliminate the discovery value depletion provisions of the present law." United States Code, Congressional and Administrative News, 83d Congress, 2d Session, Vol. 12, p. 2708.

[11] "Nature of wasting assets.—The distinguishing mark of the wasting asset is not the fact that the particular unit of property is subject to loss in value with use; this is true of most property. In the case of the wasting asset, however, it is as a rule impossible or impracticable to replace the property . . . for example . . . in the oil and gas field, although the possibilities of deeper drilling and improved methods of extraction may make the total amount to be extracted a somewhat variable quantity (*sic*). . . .

"In each case the asset is physically exhausted or consumed, unit by unit, as operations proceed. In contrast . . . a unit of equipment . . . is used in its entirety over a period of years . . . Here is the root of the distinction between the processes of depletion and depreciation." W. A. Paton, *Accountants' Handbook*, 3rd Edition (New York: The Ronald Press Co., 1944), pp. 617-618.

"The especial difficulty in the way of accurate accounting for depletion is that of estimating in advance the amount of the resource recoverable on a commercial basis . . . Short tells of a California gold mine which started production in 1850 and is still active . . . The periodic depletion charge is necessarily a rather rough estimate (*sic*), but . . . Congress evidently concluded that it was better to use such an estimate than to ignore the fact of depletion altogether.

"However . . . there are many cases of wasting resources in which it is almost impossible to find any reasonable basis on which to determine depletion." *Ibid.*, p. 629.

[12] Donald Carlisle, "The Economics of a Fund Resource with Particular Reference to Mining," *American Economic Review*, Vol. XLIV, No. 4, September 1954, p. 610.

amount of coal finally to be recovered," running from 60 to 80 percent in the United States. In addition, old mines are frequently reworked, and also rejected submarginal ore and waste may be reworked.[13] That is, in a business operation, the effective limit is reached when it becomes *unprofitable* (rather than impossible) to continue extraction. Consequently, the concept of depletion must be shifted in theory, as it already has been in practice, from a *physical-accounting* to a *monetary-accounting* frame of reference.

III. *Is Percentage Depletion Applicable to Income from Farming?*

However, what of the farmer? Is not his cultivable soil an exhaustible natural resource? The history of the exhaustion and erosion of our agricultural areas provides an indubitable argument in the affirmative. According to an economist of international reputation:

"No calculations have ever been made in any country as to the extent of exhaustion of natural fertility of soils and pastures . . . In the case of mineral and timber production the extent of exhaustion of natural resources is probably trifling compared with that which arises in agriculture."[14]

Nevertheless, whereas in oil, gas, mineral and timber production, the natural wealth is physically removed from its deposit or stand, is there any analogous condition in agriculture? Again, the answer seems to be in the affirmative, since the nitrogen in the soil is taken up physically into the plants and constitutes an essential ingredient in all agricultural produce.[15] The soil is in this manner depleted of its productive quality. If its nitrogenous content is not replaced or restored, the land becomes unproductive.

Historically we know that, just as mines are worked down to the point of diminishing returns, in somewhat similar manner, before the disappearance of the frontier, or as long as new land was to be had cheap, the old lands were frequently worked out and then abandoned. The process of rehabilitating exhausted agricultural land does not seem to be essentially different, from an economic viewpoint, from the techniques developed for the further exploitation of lowgrade iron ore deposits (e.g., the Mesabi range in Minnesota), oil wells, copper and coal mines which had been

[13] *Ibid.*, pp. 596-597.

[14] Colin Clark, *The Conditions of Economic Progress* (London: Macmillan & Co. Ltd., 1951 Edition), p. 15.

[15] "Products such as wheat, corn, milk or cotton are forthcoming only as a number of factors or resources are combined together . . . This fact is easy to visualize if we consider that commodities are produced from productive services embodied in resources as well as from the resources themselves. Production of corn involves the transformation of carbon dioxide from the atmosphere and moisture and nitrogen from the soil, along with the services of labor, machinery and tractor fuel, into a commodity. *Services such as moisture or carbon dioxide and nitrogen are actually transformed into corn.*" (Emphasis added by the writer) E. O. Heady, *Economics of Agricultural Production and Resource Use* (New York: Prentice-Hall, Inc., 1952), p. 22.

considered "exhausted" in terms of monetary values, rather than as a permanent physical fact.

A review of the exhaustive testimony presented in the Congressional hearings, preliminary to passage of the omnibus revision of the Internal Revenue Code, reveals no proposal for the provision of a depletion allowance for income from farming.[16] In this connection, L. C. Halvorson, testifying on behalf of the National Grange, stated:

> "While a number of extraction industries get depletion allowance, farmers do not. Land is not an inexhaustible resource as some seem to presume. Much of our land has lost more than half its nitrogen and humus content since it was opened. For this the farmers have been allowed no depletion allowance."[17]

What reasons can be assumed for the failure of the farmers to have petitioned for adoption of a depletion allowance for their agricultural production? This writer, having been unable to discover any discussions of the subject in the recent literature, surmises as follows:

First, the principle is long established that land is not subject to depreciation. The land is considered indestructible, even though its productive qualities may be depleted.

Second, since it is impracticable to differentiate between the cultivable soil and the farm as a whole, this would seem to have precluded the application of a manageable accounting concept or formula for depletion, in the earlier formulations of the depletion provision, when the depletion allowance was based first on cost, and later on discovery value.

Third, since the adoption in the 1926 Revenue Act of the percentage depletion provision, applicable to gross income rather than to the asset valuation, the farmers either have not considered its applicability to income from farming or have preferred to concentrate their attention on more "direct" measures of government assistance.

Fourth, the farmers may have been diffident about expecting benefits to be granted from both sides of the ledger. That is, since gross income, for a large proportion of farm operators, includes returns derived either from direct government payments, or from government supported prices, the farmers might not have pleaded persuasively that this enhanced income be further augmented by decreasing the liability for federal income tax.[18]

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[16] The law does include a new provision (Section 175) allowing farmers to charge soil and water conservation expenditures to income, either in the current year or over several years, instead of having to capitalize such outlays.

[17] *Hearings* before the Committee on Finance, United States Senate, on H. R. 8300, Part 4, April 1954, p. 1983.

[18] In regard to the question of providing a percentage depletion allowance, for deduction from income which has been enhanced by government benefit, price support and crop loan payments, we find that a related question was raised in a similar case by Representative V. A. Knox of Michigan: "There is a dual question involved if we are going to make soil-conservation payments and then also allow you to deduct

Presumably, having concentrated on killing off the parental factors of market uncertainties, the farmer could hardly ask for clemency on the ground of his being a financial orphan.

A fifth and possibly overriding reason is the fact that until 1941 most farmers were not affected by the federal income tax. The primary reason for this (other than the low level of farm income) was the tax exemption provision. Thus the minimum filing requirement for married persons was $3,500 net income in 1929, $2,500 in 1936, and $1,500 in 1941; whereas the applicable requirement for an individual now is $600, regardless of family status. We are informed that:

"From 1921 to 1940, the number of farmers paying federal income taxes and the amounts paid were still of only minor significance. In fact, as late as 1939, according to the Bureau of Internal Revenue's classification of returns by industries or types of businesses, only about 140,000 businesses were listed in the farming category."[19]

One of our leading agricultural economists, Professor John D. Black, has called attention to the situation in these words:

"An estimate was made in 1939 that in that year only 139,760 farm businesses paid federal income taxes. The estimate for 1941 was that 575,000 farm businesses paid a total of $15,000,000, of federal income taxes; and for 1943, that 1,100,000 paid $375,000,000."[20]

Farmers' federal income tax payments are estimated to have risen to a total of $960,000,000 for 1948, the top year for farm income, after which they declined to $640,000,000 for 1951, and then rose to an estimated $750,000,000 for 1952.[21] According to the BAE's analysis, "Despite several years of rising property taxes, the federal income tax retains the preeminent position among farmers' taxes which it acquired during the war years."[22] This is due, of course, to the rise in farm income, the increased tax rates (with only a slight subsequent reduction) and the reduced exemption levels.

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from income-tax payments the amount of money you use in the practice of soil conservation." From testimony in *Hearings* before the Committee on Ways and Means, House of Representatives, 83d Congress, 1st Session, Part 2, July-August 1953, p. 934. Apparently, the government's conservation payments are to be included in the base amount of taxable income from which the farmer may deduct soil and water conservation expenditures, since Section 175, as adopted, does not provide for exclusion of such payments.

[19] S. L. Crockett, "Some Probable Effects of Taxation on Farmers' Marketing Practices," *This Journal*, Vol. XXXI, No. 4, Part 1, November 1949, p. 726.

[20] John D. Black, *Introduction to Economics for Agriculture* (New York: Macmillan & Co., 1953), p. 710.

[21] United States Department of Agriculture, Bureau of Agricultural Economics, *Agricultural Finance Review*, May 1952, p. 15.

[22] G. J. Isaac, "Farmers' Taxes," *Agricultural Finance Review*, November 1948, p. 90.

However, no information is available as to how this tax burden is distributed, either by types of farms, regions, income size or family size classes.[23] The lack of data in this area is commented on repeatedly in the literature. For example, Professors Shultz and Harriss stated:

"Reliable statistics and careful analysis of the distribution of American taxes by income classes and by various groups—farmer and city dweller (etc.) . . .—are almost nonexistent. It is astonishing, perhaps shocking, that so little acceptable material can be found."[24]

In spite of the lack of information in this vital area (or possibly because of it), it is conceivable that a case can be made against any easing of the impact of federal income taxes on farmers. Thus, an article in the *National Tax Journal* alleged that although prewar tax studies showed that farmers bore a disproportionately low share of the tax burden "such a survey made today would in all probability show an even more decisive advantage for the farmer than prior to World War II."[25] The author states:

"In this single most important tax (i.e., the federal income tax) the farmer seems to be relatively better treated than most other groups. There seem to be two major reasons why this is true: first, the difficulties involved in formulating a complete statutory definition of income; and second, the administrative difficulties besetting enforcement of the statute."[26]

Professor Lampman, however, cites some factors that might support a contrary view, to the effect that the farmer may not be better treated in the current situation by the federal income tax than other groups:

"Production for home use is a decreasing part of the total national product. . . . There has been an increase in the quantity of 'bought' goods and services. . . . Inflation has had the effect of pushing the whole tax rates schedule down the income ladder. Also overall progressivity has apparently lessened because of the increase in state and local taxes, which are dominated by non-progressive forms."[27]

Mr. Henry considered that farm income is susceptible to a substantial degree of underreporting. This observation is probably applicable to income returns not only of farmers but also of other unincorporated businesses and self-employed persons. Like other writers on the subject, Mr. Henry deplored the lack of data, as implied in the following comment:

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[23] A useful survey of farmers' income is contained in *Studies in Income and Wealth*, Conference on Research in Income and Wealth, Vol. 13, Part V, N. M. Koffsky and J. E. Lear, "Size Distribution of Farm Operators' Income in 1946" (New York: National Bureau of Economic Research, 1951), pp. 220-264. This study, however, does not deal with the tax problem.

[24] William J. Shultz and C. Lowell Harriss, *American Public Finance* (New York: Prentice-Hall, Inc., 1949), p. 318.

[25] E. L. Henry, "The Farmer's Tax Burden," *National Tax Journal*, Vol. IV, No. 4, December 1951, p. 348.

[26] *Ibid.*, p. 346.

[27] R. J. Lampman, "Recent Changes in Income Inequality Reconsidered," *American Economic Review*, Vol. XLIV, No. 3, June 1954, p. 252.

"To the extent that economists can perfect their research techniques in this area of relative burdens, they will be providing the basis for what might be a more precise and rational resolution of such fiscal policy conflicts."[28,29]

It is of course true that cash receipts do not constitute the entire return to the farmer. Other forms of income are non-money income received from the farm in the form of food and shelter. Total cash receipts from farming in 1952 of $32,648,000,000 were supplemented by an estimated $2,144,000,000 as the value of home consumption, and $1,734,000,000 as the rental value of farm homes, which together constituted an addition of 12 percent to gross receipts, for a total of $36,526,000,000 gross farm income. When production expenses of $23,027,000,000 are deducted, leaving realized net income of $13,499,000,000, the significance of the non-money income factor is sharpened.[30]

IV. *Some Projected Results of Applying Percentage Depletion to Income from Farming*

As indicated above, the only series reporting farmers' payments of federal income taxes is the estimates of the BAE's *Agricultural Finance Review*. However, no information is given other than an approximation of total federal income taxes paid. What is needed is a study similar to that of Koffsky and Lear (*op. cit.*) showing the distribution of the *net taxable income* of farmers (after deduction of operating costs and personal expenses) by income size class, family size, and type of farm and region; and also—especially—the federal income taxes paid thereon.

This writer has drawn on some rough approximations of farmers' net taxable incomes, in order to have a basis for estimating the effect of the application of a percentage depletion provision to farm income. A series of estimates of net taxable income, for particular groups of farmers, has been found in a seven page memorandum issued by the Farm Credit

[28] *Op. cit.*, p. 348.

[29] Koffsky and Lear found that "Farm receipts are generally understated in income surveys, partly because respondents do not remember the numerous transactions involved in operating the farm during the year and partly because they are reluctant to disclose figures. It is harder for the farm operator to remember each item of his income than it is for most other occupational groups. Wage earners, for example, usually have fixed rates of earnings, easy to remember and report, and also relatively easy to check upon. In the Census-BAE survey of income in 1946, more than 90 percent of urban wages and salaries was reported but apparently only about half of net cash farm income. The marked understatement of farm operators' income in comparison with both the actual farm income and the reported income of other groups led us to try to show what its size distribution would be if it had been fully reported. The adjustments were facilitated by the high proportion of gross cash farm income and production expenses reported in the survey as compared with the estimate of the BAE for 1946." *Op. cit.*, pp. 221-222.

[30] United States Department of Agriculture, *Agricultural Statistics 1953* (Washington: United States Government Printing Office), p. 609, Table 706.

Administration, dealing with a secondary aspect of this subject.[31] It contains two tables. One table lists "Rough estimates of federal income taxes that will need to be paid by farmers with different amounts of net income and numbers of dependents." The vertical class distribution is for net income classes of $500, $750, $1,000, $1,500, $2,000, $3,000, and varying steps up to $200,000. The horizontal distribution is for family status, ranging from "Single person with no dependents" to "Man and wife with 5 dependents."

The other table lists "Rough estimates of 1952 income taxes payable on the income of different kinds and sizes of farms."[32] Twelve types of farms are included, ranging from Northeast Ohio dairy farms to Southeast Kansas mixed farms, including regional types from seven states: Ohio, Kentucky, Wisconsin, Minnesota, North Dakota, Iowa and Kansas. Each of the twelve types is broken down into three classes: small, medium and large, for a total of 36 classes. For each class, data are given for value of farm, gross cash farm income, net farm income, and rough estimate of 1952 federal income tax payable for two family types: first, man and wife with no dependents, and second, man and wife with three dependents.[33]

The hypothetical problem we are facing is: What would be the effect on the *individual amount of taxes payable,* of a *10 percent depletion allowance,* applicable to gross cash farm income? In order to derive such an estimate, the FCA data have been adjusted, by first deducting 10 percent of the *gross income* of each of the 36 classes from each class's *net income;* and then deriving new tax estimates for the same two family types used in the FCA table.

The results are shown in the accompanying table, in the form of frequency distributions classified according to, first, the dollar amount of the resulting tax reduction; and second, the percentage tax reduction, accruing to each of the 36 farm types. The larger absolute dollar reductions generally accrued, as is to be expected, to the larger farms. However, the percentage reduction showed some tendency to vary inversely in respect to the three size classes.[34]

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[31] Farm Credit Administration, Economic and Credit Analysis Division, "Effect of Federal Income Taxes on Debt Paying Ability of Farmers" (mimeographed, April 1952).

[32] The sources listed for the data are research bulletins of colleges and universities in the seven states covered.

[33] That is, for man and wife with no dependents, the federal income tax starts at net taxable income of $1,333 (representing two dependent-deductions at $600 each, plus 10 percent of $1,333 as the "standard" deduction for personal expenses); and for man and wife with three dependents, at $3,333 (representing five dependent-deductions at $600 each, plus 10 percent of $3,333 as the "standard" deduction).

[34] The irregular pattern of these results reflects the wide variations in the basic data. For example, the FCA reported for small Kentucky tobacco-livestock farms gross income of only *$2,813* and net income of *$1,797;* and, by way of contrast,

EFFECT ON TAX LIABILITY OF APPLICATION OF A 10 PERCENT DEPLETION ALLOWANCE
DISTRIBUTION OF 36 FARM CLASSES ACCORDING TO *Dollar Amount* OF TAX
REDUCTION BY FAMILY STATUS AND FARM-SIZE-CLASS

Reduction in Taxes, Dollars	Number of Farms							
	Man and Wife with no Dependents				Man and Wife with Three Dependents			
	Farm-Size							
	Small	Medium	Large	Total	Small	Medium	Large	Total
$ 0– 99	3	1	0	4	0	2	0	2
100–199	4	2	2	8	2	3	2	7
200–299	1	3	2	6	0	0	1	1
300–399	0	3	2	5	0	2	2	4
400–499	1	2	1	4	0	1	1	2
500–749	0	1	2	3	0	0	2	2
750–1000	0	0	3	3	0	0	2	2
Zero Tax on Income *Before Adjustment*	3	0	0	3	10	4	2	16
Total	12	12	12	36	12	12	12	36
DISTRIBUTION OF 36 FARM CLASSES ACCORDING TO PERCENTAGE OF TAX REDUCTION								
0 –24.9	0	1	1	2	0	0	0	0
25.0–49.9	1	4	7	12	0	2	3	5
50.0–74.9	3	4	2	9	0	1	2	3
75.0–99.9	0	1	1	2	0	0	3	3
100.0	5	2	1	8	2	5	2	9
Zero Tax on Income *Before Adjustment*	3	0	0	3	10	4	2	16
Total	12	12	12	36	12	12	12	36

The effects of percentage depletion allowance may be expected to have some "progressive" characteristics. A comparison of two hypothetical cases "A" and "B," where the amounts of gross and net income received by "A" are half of those received by "B," and where both "A" and "B" are "man and wife with three dependents," gives the following results of the application of a percentage depletion allowance of 10 percent:

Item	*Case A*	*Case B*
1. Gross income	$10,000	$20,000
2. Net income	$5,000	10,000
3. Percentage depletion allowance (10% × 1.)	1,000	2,000
4. Adjusted net income	4,000	8,000
5. Tax applicable to 2.	335	1,380
6. Tax applicable to 4.	135	940
7. Tax saving in dollars (5. — 6.)	200	440
8. Tax saving in percent (7. ÷ 5.)	59.8%	31.9%

for small Southwest Minnesota farms gross income of *$19,165* but net income of only *$1,506*. There are so many variable factors involved as to indicate the necessity of a farm-by-farm analysis to obtain definitive results.

For all taxpaying farmers (except for incomes in the very low taxable range) the beneficial effect of percentage depletion would be a function of two factors, the level of gross income and the spread between gross and net income. For each $1,000 of gross income, to which a 10 percent deduction would be applied, the tax saving would be $20 or more depending on the individual's tax bracket. The significance of a percentage depletion allowance is heightened by the fact that the rise in farm production expenses has considerably widened the spread between gross and net income, as the following figures show:[35]

GROSS AND NET CASH INCOME FROM FARMING[a]

Year	Total Cash Receipts	Production Expenses	Realized Net Income	Net as % of Gross	Exp. as % of Gross
	($ Millions)	($ Millions)	($ Millions)		
1947	30,020	17,228	12,792	42.7	57.3
1948	30,464	18,916	11,548	37.9	62.1
1949	28,129	18,170	9,959	35.4	64.6
1950	28,611	19,704	8,907	31.1	68.9
1951	33,085	22,317	10,768	32.6	67.4
1952	32,648	23,027	9,621	29.4	70.6
1953	31,188	22,600	8,588	27.5	72.5

[a] Excludes non-money income, i.e., value of home consumption and rental value of farm homes.

The rising proportion of production expenses to gross income reflects the increased cost of farm machinery, wages, local taxes, and most other items which enter into farm production, as well as the phenomenon of the relative rigidity of prices paid by farmers as compared with the substantial decrease since 1951 in prices received by farmers.[36]

[35] Data for 1947-1952 from *Agricultural Statistics 1953* (op. cit.). Data for 1953 computed from monthly figures in United States Department of Commerce, *Survey of Current Business*, March 1954, p. S-2.

[36] *Indexes of prices received by farmers and prices paid by farmers* (1910-14 = 100)

Year	Prices received by farmers	Prices paid by farmers
1945	207	190
1946	236	208
1947	276	240
1948	287	260
1949	250	251
1950	258	256
1951	302	282
1952	288	287
1953	258	279
1954 (April)	257	283

From *Agricultural Finance Review*, May 1954, p. 28, table 25.

V. *Broader Implications*

The general problem may be restated in this manner: What measures or techniques are available to increase the farmer's net income, without requiring of him an excessive relinquishment of the power of decision, in respect to production and marketing? A great deal has been written elsewhere on the effects of such aids as subsidies, price supports and direct payments by the government, which are necessarily related to allocations and restrictions of crops and acreage. Direct aid implies direct control. Floors under prices are inevitably covered by ceilings on production. The farmer cannot, presumably, eat his cake and have it too.

The remedy for direct controls would be the substitution of *indirect* aid for direct. Among indirect aids to the economy available from the federal government, none is more important than tax adjustments. On this subject, we have been told by the Council of Economic Advisers:

"Probably the single most effective method by which the Government could stimulate consumer spending and business investment, if needed during an adjustment period, would be well-designed tax reductions. For example, reductions in corporate income taxes can improve cost-profit ratios, while the lowering of personal income and excise taxes would energize markets. As has been emphasized in the discussion of current fiscal policy, it is premature to be talking about reducing taxes now (i.e., July 1952). This is an appropriate time, however, to begin analyzing, as part of further study of the longer range outlook, various alternative patterns of future tax adjustments and reductions with a view to determining what pattern would give the best balanced stimulus to consumption and private investment."[37]

The problem of stimulating both consumption and business investment by farmers is necessarily related to their income level and business prospects, but constitutes a separate topic in itself. Here we are concerned with the question of whether the application of percentage depletion to income from farming can be made an instrument of a flexible policy of *indirect* controls, or possibly *decontrols*, in respect to farming. If such a proposal should receive serious consideration, presumably the determination of varying schedules of the rates of percentage depletion, as between crops and from year to year, would be a government function—admittedly both difficult and controversial. However, the eligibility of the millions of farmers for the benefits of percentage depletion would, it is hoped, be unrelated to "compliance" with any rules other than the standard filing requirements which would be set up by the tax authorities.

The magnitude of the effect of such a measure as is here suggested can only be very roughly estimated, because of the absence of data. Only the tax returns, themselves, in the files of the Internal Revenue Service,

[37] *The Midyear 1952 Economic Review:* A Report to the President by the Council of Economic Advisers; supplement to *The Midyear Economic Report of the President,* transmitted to Congress July 19, 1952 (Washington, U. S. G. P. O.) p. 119.

could supply either the coverage or the detailed information in regard to gross and net income, type and size of farm, and family composition. However, a rough approximation can be attempted.

The Bureau of the Census reported the total number of farms in 1950 as 5,379,250.[38] Total cash receipts from farming in 1950 was reported as $28,611,000,000, and realized net cash income as $8,907,000,000 (in both cases excluding non-money income). The average cash income per farm unit—from *farming*—therefore was $5,318 gross and $1,656 net. At these levels the great majority of farm families were probably tax-free, except insofar as the income from the farm was supplemented by other earnings, to an extent which would bring net taxable income into a higher (i.e., taxable) bracket.[39]

There is no doubt that the minority of farmers, who have been the major recipients of the price support benefits, would be in a similar position in respect to the suggested depletion allowance. President Eisenhower taxable) bracket.[39]

"The chief beneficiaries of our price support policies have been the 2,000,000 larger, highly mechanized farming units which produce about 85 percent of our agricultural output. The individual production of the remaining farms, numbering about 3,500,000, is so small that the farmer derives little benefit from price supports."[40]

The President stated that "in 1949 . . . 22 perecnt of all farms accounted for 73 percent of the Nation's gross cash farm marketings."[41] Applying these estimates to the Census figures cited above, we find that approximately 1,185,000 farmers (i.e., 22 percent of the 5,379,250 total) accounted for some $20,900,000,000 gross cash farm income (i.e., 73 percent of the $28,611,000,000 total), and $6,500,000,000 net income (i.e., 73 percent of the $8,907,000,000 total), for an average of $17,650 gross and $5,500 net for each farm in this class.

For this average commercial farm unit a depletion allowance of 10 percent of gross income, or $1,765, deductible from net taxable income,

[38] United States Bureau of the Census, *Statistical Abstract of the United States* (74th Edition, Washington, 1953) p. 635, table no. 740.

[39] A study of size distribution of farm operators' income in 1946 reported that of 5,859,100 farms 2,645,700, or 45.2 percent, had net cash *total income* of less than $1,000, and 3,314,900, or 56.6 percent, had less than $1,500. (Koffsky and Lear, *op. cit.*, table 12, p. 238). In 1949, we are informed that 29 percent or approximately 1,500,000 farmers were netting *from all sources* less than $1,000 of cash income. From *The Economic Report of the President,* January 28, 1954 (Washington, U. S. G. P. O.), p. 91.

[40] *The President's Special Message on Agriculture* (House Document No. 292, Congressional Record, Jan. 11, 1954) p. 114.

[41] *The Economic Report of the President,* op. cit., p. 91.

would represent a tax saving of approximately $353 (i.e., 20 percent of $1,765). Average tax savings of $353 each for these 1,185,000 farmers alone would total $418,000,000, or 65 percent of the estimated total taxes paid of $640,000,000 in 1951, on income earned in the preceding calendar year (i.e., 1950).[42]

It is apparent that a 10 percent depletion allowance would constitute a substantial benefit to the farm businesses of the country. These extremely tentative estimates have been computed in an attempt to indicate the proximate financial result that a 10 percent depletion allowance on all cash receipts from farming would be likely to have. The aggregate effect of such a provision would be important for the Treasury and for the economy as a whole. Even more interesting, if less important than the aggregate effect, would be a determination of its impact on the individual farmers, according to type and size of farm, size of family, region and product classification.

A consideration of the various kinds and amounts of benefit payments to farmers under present programs is outside the scope of this paper, but would be relevant to an exploration of all the implications of the proposal. For example, it is reported that from 1947 (i.e., dating from the abandonment of the food subsidy programs under price controls) through 1953, the amounts paid out to farmers under rental and benefit, soil conservation, price adjustment, price parity, Sugar Act, and production programs have totaled $1,813,000,000 for the seven years, for an average of $259,000,000 annually.[43] (This excludes price-support loans and direct purchases for inventory (net of repurchases) by the Commodity Credit Corporation, which totaled some $5,000,000,000 for the years 1948-53 and $3,200,000,000 in 1953 alone.[44]

A significant implication of the proposal is that, to the extent that the suggested depletion allowance could be utilized to replace or offset other benefit programs, the net cost to the Treasury would be correspondingly reduced.

VI. A *Question of Coverage*

A further difficulty may be anticipated in the application of percentage depletion to income from farming in the fact that more than half the cash receipts from farming is from the sale of livestock and its products, ranging in the postwar years from a low of 55.0 percent of total receipts

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[42] *Agricultural Finance Review*, May 1952, p. 15.

[43] Computed from *Agricultural Statistics 1953* (op. cit.).

[44] United States Department of Commerce, *Survey of Current Business*, April 1954, p. 4.

in 1949 to a high of 59.7 percent in 1951, the figure for the latest year, 1953, being 55.5 percent.[45]

That is, the problem may arise whether the application of the depletion principle to agricultural production would provide for the inclusion of *all farm income* or of only the income derived from the *direct produce of the soil.* The latter procedure would have a discriminatory effect which would be similar to that frequently criticized in our present farm programs which favor certain products and producers and exclude others. No doubt the depleting effect of farming on the properties of the soil varies considerably according to whether the land is used for cotton, corn, wheat, tobacco or alfalfa; or for fruit orchards, tree farming, vegetables, grazing, livestock or poultry farming. However, according to expert opinion, *in any case the soil is being depleted:*

"Every time a farmer sells a bushel of grain or a pound of meat, produced on his land, he is disposing of plant food elements drawn from his soil that represent part of his capital assets and must be replaced by good husbandry."[46]

The above statement was made with reference to Section 175 of the new Internal Revenue Code, which permits the deduction from taxable income of soil and water conservation expenditures, in an amount not exceeding 25 percent of the gross income derived from farming during the taxable year. Discussing this new provision, the Senate Finance Committee posited the following definition:

"The phrase 'gross income from farming' means the gross income of the taxpayer from the production of crops, fruits or other agricultural products *or from livestock.*"[47]

Therefore it is not unreasonable to suppose that, if consideration should be given to the application of percentage depletion to income from farming, a definition may be adopted with a broad coverage similar to that reported above in connection with soil and water conservation expenditures.

VII. *Conclusions*

Having presumed to venture thus far, this paper will be concluded with some summary observations that may provide grounds for further explora-

[45] Data for 1953 computed from *Survey of Current Business,* March 1954, p. S-2; previous years from *Agricultural Statistics 1953* (op. cit.).

[46] Testimony of A. M. Hedge, Chief of the Farm and Ranch Planning Division, Soil Conservation Service, United States Department of Agriculture, in *Hearings* before the Committee on Ways and Means (op. cit.), p. 927.

[47] Senate Report No. 1622 (op. cit.), pp. 216-217. (Emphasis added by the writer).

tion of the possibilities inherent in the application of percentage depletion to income from farming.

1. The principle is not new, either from the statutory or economic experience. It is already written into law and has been in operation for many years in respect to many industries.

2. Its benefits would accrue to the farm population at large.

3. It is independent of all other farm programs.

4. It could be explored either as a supplement to, or as a gradual replacement of, other forms of farm aid.

5. It would come into play at the far end of the production-marketing process.

6. It avoids involvement with the sensitive areas, of prices, production and marketing, and aims at reducing the direct participation of the government in the economic process.

7. Though national in scope, covering the numerically greatest entrepreneurial group in the country, it should be simple and inexpensive to administer.

8. It is purely an accounting procedure, and could possibly be subsumed completely under a single line of the annual income tax return.

9. It would have the same effect as a substantial reduction in production expenses, without any change in the price of items bought by farmers.

10. The determination of depletion rates could be made *ex post*, in respect to the production year.

11. It would encourage more complete reporting of gross income by taxpaying farmers, to enable them to claim the maximum deduction.

12. It should have a stimulating effect on the nonagricultural employment of the farm population, since it would raise the level at which total earnings would become subject to taxation.

13. By means of carry-back and carry-forward provision, it could be used by farmers to average out gains and losses over a reasonable period of time.

14. It would represent a new form of flexible fiscal policy, and could be adjusted to cyclical changes in farm and national income.

A basic characteristic of all forms of government assistance is the implicit transfer of income from other sectors of the economy to the groups aided. The purposive justification for such transfers is that the shift of the burden, or at least any ostensible inequity, is primarily a short-run phenomenon; that the long-run effect is to stimulate a higher level of production than would otherwise be forthcoming, and thus to increase investment, employment and income. What are seemingly private favors are thus allegedly converted into public benefits. Of course, the lobbyists for every economic group make similar claims.

Economists and legislators have the duty of working out the balance on a national scale that will attempt to provide the optimum distribution of income, at the maximum attainable level of production. It is in the interest of this fundamental objective that this suggestion for consideration of the application of percentage depletion to income from farming is advanced.

PROGRAMMING WITH CONSIDERATION OF VARIATIONS IN INPUT COEFFICIENTS*

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THE linear programming technique promises to become an important tool for production planning in farming. As a semi-research tool that assumes coefficients without variance, it promises to replace the less complex programming technique long known as budgeting. The main advantage of linear programming over its near-relative, budgeting, is in the greater magnitude and complexity of problems that can be handled by the new technique. As used heretofore, both methods generally assume that the input coefficients are known with certainty and that the price situation is one of statics.

The assumption of input coefficients that are known with certainty does not pose a great problem in planning the optimum program for a feed mixing plant, or other industrial concern where the product is scarcely a function of weather and similar vagaries. The magnitudes of the resource/product coefficients are often well known before mixing is begun; the values realized at the time of the mixing process usually are quite similar to those expected. In primary production of farm crops, however, the situation is quite different. Yields are clearly a function of rainfall, temperature, insects and other variables outside the realm of resources that the farmer can specify. Therefore the resource/product coefficients vary from year to year, as yields fluctuate with variables exogenous to the decision-making realm of the farm firm. The final outcome of the farm's production plan depends not only on these natural fluctuations (exogenous variables) but also, to an extent, on a use of resources inputs (endogenous variables) differing in magnitude from those originally planned. The farmer may not "follow to the letter" his planned schedule of capital and labor for each month and crop. He may decide to use a little less capital and machine services on oats in July and divert it to corn instead. The "exogenous" and "endogenous" variables interact to give production outcomes different from those originally expected. Even with prices constant, the input/output coefficients can take on several magnitudes and the most profitable production plan will vary accordingly. If one is interested in knowing the possible range or distribution of possible outcomes, he must consider the possible fluctuations in the input/output coefficients. If the fluctuations in the coefficients are random, it is

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possible to estimate, for planning purposes, the expected values of the coefficients; also, it is possible to investigate the effect of their variation on the outcome of the final program.

Planning with Variation in Input/Output Coefficients

This paper presents such an exploratory analysis for an Iowa farm situation. It explores the ranges of possible outcomes in production plans when variations in input/output coefficients are known to exist. The first section which follows includes estimation of the optimum cropping program when the input/output coefficients are equal to the mean of the period of years studied. The second which follows includes specification of outcomes for various probability levels where variance in input/output coefficients exists. The treatment considers prices to be constants. (Hence, it still does not treat one of the major variations and uncertainties in agriculture.)

The yield data that serve as a basis for this study were taken from the assessor's annual report for Ellsworth Township in Hancock County, Iowa. Yields were obtained for corn, oats, soybeans, flax and wheat for each year in the period 1928-52. Trend was removed from each yield series in order to put all yields on the basis of current techniques; deviations from trend were retained to explore the effect of variations in input/output coefficients on the optimum program. These adjusted yields were then employed directly to obtain the crop/land coefficients. A "budgeted" farming method was then devised and crop/capital and labor/capital coefficients were computed accordingly. Coefficients were computed for labor of each month (i.e. labor in each month was considered a different resource). Capital inputs are annual expenses including outlays for seed, fertilizer, fuel, oil, grease, machine repairs, depreciation, etc. The average coefficients for the entire period 1928-52 were used in determining the optimum program outlined immediately below. The coefficients for each individual year were used in establishing variance quantities for the section on "statistical predictions."

Optimum Program Based on Mean Coefficients

The purpose of program planning is to determine how scarce or limitational resources should be allocated among competing alternatives to give the greatest profit. In these cases the competing alternatives are corn, oats, soybeans, flax and wheat. We wish to determine how much of each should be produced if maximum returns are to be obtained from given resources. We employ a farm situation that has the following given stocks of resources to allocate among the five competing crops. (Only three months of labor are indicated since other months are not limitational.)

Resource	Available Quantity
Land	148 acres
Capital for expenses	$1800.00
May labor	182 hours
July labor	234 hours
August labor	234 hours

The first step in computing the optimum plan is estimation of the input coefficients; that is, determining the amount of a particular input required to produce a bushel of corn, oats and so on. As stated previously, the averages of the series over the period 1928-52 are the expected values for planning the production program. (The unbiased estimates of their variances are used for making statistical predictions in the next section.) A simple comparison of the available labor and the monthly requirements indicated that labor in the months of May, July and August, alone, may be restrictive. Since the labor supply in the other months is greater than requirements for any possible program, these months need not be included in the computations. Only the three months are considered to be limitational for labor. The optimum program derived, however, was checked later for labor requirements during the other months. The 1928-52 average input coefficients (i.e., amount of each resource required to produce one unit of product) used in deriving the optimum program are given in Table 1.

TABLE 1. MATRIX OF INPUT COEFFICIENTS

	Corn	Oats	Soybeans	Flax	Wheat
	x_1	x_2	x_3	x_4	x_5
Land (acre/bu.)	.02274	.02770	.05862	.09249	.09081
Capital expense ($/bu.)	.31772	.27870	.70812	.96956	1.00356
May (labor/hr.)	.05253		.11681		
July (labor/hr.)	.02555	.07523	.05485	.21186	.42324
August (labor/hr.)		.08370		.30910	.08650

The prices used in the objective function (i.e., in determining the program that gives the maximum gross return) are given in Table 2.[1] They are Iowa average prices for the year 1952.

From these data, formulation of the problem and derivation of an opti-

[1] The goal in the particular problem is to determine the program that gives the maximum gross revenue. This program also gives the maximum net revenue, since all resources are given as fixed supplies; i.e., will go unused if not required for the production program.

TABLE 2. PRICES OF CROPS

Crop	Price/Bu.
Corn (x_1)	$1.56
Oats (x_2)	.84
Soybeans (x_3)	2.79
Flax (x_4)	3.81
Wheat (x_5)	2.14

mum program represents a straightforward application of the simplex method.

With the introduction of the disposal variables x_6, x_7, x_8, x_9 and x_{10} and using the simplex method, the following program was derived.[2]

$x_1 = 3464.5$ (bushels of corn produced)
$x_4 = 686.7$ (bushels of flax produced)
$x_6 = 5.7$ (acres of land unused)
$x_7 = 33.4$ ($ of capital unused)
$x_{10} = 21.7$ (hrs. of August labor unused)

Thus, the optimum plan under "mean expectations" of input coefficients, which includes 3464.5 bushels of corn and 687 bushels of flax, will require the inputs or resource allocations shown in Table 3.

TABLE 3. SCHEDULE OF INPUTS

Input	Unit	Corn	Flax	Disposal	Total Supply
Land	acres	78.78	63.52	5.70	148
Capital	dollars	1,100.75	665.83	33.44	1,800
May labor	hours	182			182
July labor	hours	88.51	145.49		234
August labor	hours		212.27	21.73	234

The expected gross profit from the optimum program, which includes only corn and flax, is $8,021. The program outlined is most profitable when the input coefficients (and, consequently, the basic yields used) are those shown in Table 1 and prices are those shown in Table 2. Under other yield and input coefficients, however, different programs and profit outcomes are possible. We are now ready to examine these statistics where we consider variation in input coefficients.

Statistical Predictions

The expected yields and the levels of disposal activities entering the optimum program satisfy a set of linear equations equal in number to the variables involved. The input coefficients are a function of yields and resources used. For example, the capital input coefficient represents the

[2] x_8 and x_9, disposal activities for May and July labor respectively, do not show up here because their supplies are completely used for crops.

capital required per bushel. But at the actual time of production the input values may be different due to weather alone or to slight random deviations, on the part of the farmer, from the planned input schedule.[3] Thus, there will be a random error that will enter in the coefficients. As a result of these errors, the program may well differ from the expected values based on the mean of the 1928-52 period. The question is: Can these variations in the results be predicted? In other words, if we plan a program in terms of the "mean outcome" described previously, what probabilities attach to production and profit outcomes of different magnitudes?

Procedures are possible that allow us to make predictions about the relative variations in the yields and the profit function. Answers derived from them are outlined below; details of the procedures are outlined in the appendix. They are based on the following assumptions.

(1) The errors in the input coefficients (that is, the deviation of the "operating" values from the value of the coefficients used in the planning above) are random.
(2) These errors are small relative to the values of the corresponding input coefficients.
(3) They are normally distributed with mean zero and known variances.

We will present in the following pages the results obtained with the help of these procedures for the "mean program" explained in the section above. While the prices and the resource supplies were not considered to have small random variation, the procedures suggested can also take into account such errors. In this study it can be verified that only three variances were needed (i.e., in terms of potential limitational resources). These were computed from the corresponding series of input coefficients calculated over the entire period 1928-52 and include: (1) The variance of the labor input coefficient for May for corn which is .000227125. (2) The variance of the labor input coefficient for July for flax which is .003262968. (3) The variance of the labor input coefficient for July for corn which is .000053646. From these estimated variances, and by the direct application of the quadratic equations in the appendix, the following 95 percent confidence limits are obtained.

		Lower Limit	*Upper Limit*
Corn (x_1)	bushels	2,088	10,282
Flax (x_4)	bushels	46.5	1,625
Gross profit (y)	dollars	6,298	18,866

In other words, there is only about a 5 percent chance, if the "mean expected" program of Section I is put into effect, that corn production will be less than 2,088 bushels or more than 10,282 bushels, as a result

[3] For example, it is noticed in Table 3 that, for the month of July, there is no extra labor (for disposal). Hence, if labor used on corn is more than 88.51 hours, it may result in less than 145.49 hours being used on flax.

of the random error in the input coefficients. Similarly, the flax production will lie between 46.5 bushels and 1,625 bushels, with 95 percent probability. For gross profit, the lower limit is 6,298, and the upper limit is $18,866. The lower limits are closer to the anticipated values (the "mean expected" values of the program in Section I) than are the upper limits. From a planning point of view, these last results are very important. The entrepreneur not only knows the extent of variability of the results; he knows also that the lower limit of the gross profit, $6,298, is only $1,723 less than the gross profit of the "mean expected" program. Hence, he might well have increased confidence in actual application of the "mean expected" program.

Further, following the procedure of the appendix, the following probability statements can be derived:

(i) *Corn Production* (x_1)

Prob. ($x_1 < 2{,}000$) = .0277. This figure means that the probability that corn production, under the "mean expected" program, will be less than 2,000 bushels is about 2.8 percent.

Similarly, Prob. ($x_1 > 10{,}000$) = .0208 means that the probability of corn production greater than 10,000 bushels is about 2.1 percent.

(ii) *Flax Production* (x_4)

Prob. ($x_4 < 50$) = .027, Prob. ($x_4 > 1{,}600$) = .0228, means that the probability of flax production less than 50 bushels is 2.7 percent, and greater than 1,600 bushels is about 2.3 percent.

(iii) *Gross Profit* (y)

Another interesting question is this: What is the probability for simultaneous occurrence of corn production less than 2,000 bushels and flax production less than 50 bushels? The solution to this question depends on the joint distribution of x_1 and x_4, which our procedure does not describe. However, a solution can be provided indirectly by considering the profit function (y). If both lower limits are realized simultaneously (that is, if $x_1 = 2{,}000$ and $x_4 = 50$), the gross profit will be ($1.56) (2,000) + ($3.87)(50) = $3,310.50. However, it was determined, using the procedure of the appendix, that the probability of a return as low as $3,310.50 is practically zero.

Similar calculations can be made to determine the probability of gross profits falling at different levels. The following results have been obtained.

Prob. ($y \leq 6{,}500$) = .0276

Prob. ($y \geq 10{,}000$) = .17

Prob. ($y \geq 18{,}000$) = .0232

Thus, if the "mean expected" optimum program of the previous section is carried on and variations (such as those realized in the period 1928-52) occur, the probability that the outcome will give a gross profit of $6,500 or less is 2.8 percent; the probability of a gross profit equal to or greater

than \$10,000 is 17 percent; the probability of a return equal to or greater than \$18,000 is only 2.3 percent.

The procedures outlined in the appendix provide the method for determining these probabilities. If more than one optimum program can yield equal profit, the one that gives the highest lower limit, at a stated level of probability, indicates the program that is "least risky" (or, contrariwise, the program that stands to give the greatest return at a given probability level).

APPENDIX

Suppose $x_1, x_2, \cdots, x_m$ are the activity levels, active or disposal, that enter into the optimum program. $q_1, q_2, \cdots, q_m$ are the amounts of fixed inputs available. (In an interindustry analysis, these may represent the "bill of goods"). Then the following set of equations defines the "operating" model.

$$\begin{aligned}
b_{11}x_1 + b_{12}x_2 + \cdots + b_{1m}x_m &= q_1 \\
b_{21}x_1 + b_{22}x_2 + \cdots + b_{2m}x_m &= q_2 \\
b_{31}x_1 + b_{32}x_2 + \cdots + b_{3m}x_m &= q_3 \\
\cdots\cdots\cdots

$$\sigma_B^2 = \sum_{i=1}^{m} \sum_{j=1}^{m} (\beta_{ij})^2 \sigma_{ij}^2$$

where σ_{ij}^2 is the variance of the input coefficient b_{ij}, τ_j^2 is the variance of the "fixed" input q_i (if any variation in the supply of these factors is assumed to exist, though small and normally distributed, at least as an approximation) and β_{ik} is the cofactor of b_{ik} in the determinant $|B|$ and $D_{ij}^{(k)}$ is the cofactor of the element in the i-th row and j-th column of the matrix $D^{(k)}$.

(4) Similarly, compute σ_{Bk}.

$$\sigma_{Bk} = \sum_{i=1}^{m} \sum_{\substack{i=1 \\ j \neq k}}^{m} D_{ij}{}^{k} \beta_{ij} \sigma_{ij}^2$$

(5) Find a positive number y from tables of normal distribution such that

$$p[\,|\,N(0, 1)\,|\,\leqq y] = \alpha,$$

where α is the confidence coefficient of concern.

(6) Finally, use the equation

$$[\beta^2 - \gamma^2 \sigma_B^2]Z^2 - 2[\beta\partial_k - \gamma^2 \sigma_{Bk}]^2 Z + [\partial_k{}^2 - \gamma^2 \sigma_k{}^2] = 0$$

to find the two confidence limits (the roots of this equation, say, Z_1 and Z_2). Then $p[Z_1 \leqq x_k \leqq Z_2] = \alpha$. Now suppose we want to know the probability that x_k is not less than a given number V. Then, we follow these steps: Compute β, ∂_k, σ_k^2, σ_B^2, and σ_{Bk} as above. Next, find:

$$h = \frac{\beta}{\sigma_B}$$

$$k = \frac{\partial_k - V\beta}{[\sigma_k{}^2 - 2\sigma_{Bk}V + \alpha_B{}^2 V^2]^{1/2}}$$

and

$$\rho = \frac{[\sigma_{Bk} - V\sigma_B{}^2]}{\sigma_B[\sigma_k{}^2 - 2\sigma_{Bk}V + V^2\sigma_B{}^2]^{1/2}}.$$

Using Karl Pearson's Table for Statisticians and Biometricians (part II, Tables VII and IX), we find the two probabilities for linvariate normal distributions:

$$\int_h^\infty \int_k^\infty N(\rho) + \int_{-h}^\infty \int_{-k}^\infty N(\rho).$$

Tables are given for positive values of h and k only. If either of these are negative, we use the following formula:

$$\int_{-h}^\infty \int_{-k}^\infty N(\rho) = 1 - \int_h^\infty N(0, 1) - \int_{+h}^\infty \int_{+k}^\infty N(\rho).$$

The sum of these probabilities gives the solution of interest to us:[4]

$$\text{Prob. } [x_k \geqq \nu].$$

Linear function

For limits of the linear function $\sum_{i=1}^{m} c_i x_i$, we establish the limits from the following steps:

(1) Compute ∂_y using

$$\partial_y = \sum_{\Sigma=1}^{m} C_r \left| D^r \right|$$

(2) Compute $\sigma^2_{N(y)}$ using

$$\sigma_{N(y)}{}^2 = \sum_{r=1}^{m} \left(\sum_{i=1}^{m} C_i B_r \right)^2 \tau_i{}^2 + \sum_{r=1}^{m} C_r{}^2 \sum_{i=1}^{m} \sum_{\substack{j=1 \\ j \neq r}}^{m} (D^r_{ij})^2 \sigma_{ij}{}^2.$$

(3) Compute $\sigma_{BN(y)}$ as

$$\sigma_{BN(y)} = \sum_{r=1}^{m} C_r \sum_{i=1}^{m} \sum_{\substack{j=1 \\ j \neq r}}^{m} D^r_{ij} B_{ij} \sigma_{ij}{}^2.$$

(4) Then for the limits use the following formula:

$$[\beta^2 - \gamma^2 \sigma_B{}^2] Z^2 - 2[\beta \partial_y - \gamma^2 \sigma_{BN(y)}] Z + [\partial_y{}^2 - \gamma^2 \sigma_{N(y)}{}^2] = 0.$$

γ is computed as at the outset; then the roots Z_1 and Z_2 give the limits such that Prob. $(Z_1 < I < Z_2) = \alpha$. For statements of the cumulative probability type, we proceed as before, except that

$$h = \beta / \sigma_B \text{ as before}$$

$$k = \frac{\partial y - V\beta}{[\sigma_{N(y)} - 2\sigma_{BN(y)} V + V^2 \sigma_B{}^2]^{1/2}}$$

and

$$\rho = \frac{}{\sigma_B [\sigma_{N(y)}{}^2 - 2\sigma_{BN(y)} V + V^2 \sigma_B{}^2]^{1/2}}.$$

Then the two double integrals give the probability that $(y \geqq \nu)$.

Again, the reader should be reminded that the above analysis is subject to these assumptions: the errors in the input coefficients are random, small and normally distributed.

[4] If any of the input coefficients or other constants are without possible random fluctuations, or if the quantities of inputs (Q) are assumed fixed, we put the corresponding variances equal to zero.

GEOGRAPHIC DIFFERENCES IN RETURNS TO IOWA FARMERS: 1869-1950

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THE agricultural sector of the Iowa economy is used for testing certain hypotheses relating to economic growth and operation of factor markets. The particular theoretical significance of agricultural development in Iowa lies in the apparently persistent differential in incomes to farm workers in the different regions of the state as measured in terms of gross income per farm worker. It is paradoxical that this difference should persist in an area that apparently has high degrees of mobility and where there is considerable knowledge of alternative opportunities in a context meeting accepted definitions of competitive enterprise. Iowa agriculture, like other large sectors of American agriculture, is characterized by the proliferation of small, independent firms and seems to possess no important barriers to mobility and information. Transportation and communication systems are well developed; literacy rates are remarkably high. Production methods and types-of-farming appear to be rather homogeneous, which implies that mobile labor would have to make little, if any, adaptation of existing skills.

Other facts emphasize the paradoxical quality of income differentials by regions in Iowa. The state's low income areas are in close proximity to its high income areas. The level of income in the poorest areas is well above that of the problem areas of American agriculture such as the Appalachian region and the Mississippi Delta, implying an increased ability to finance population movement when deemed necessary.

Purpose and Procedure

The purpose of this paper is to present the results of a study of the persistence of regional income differentials in Iowa over a long period and to examine certain hypotheses related to these differentials.

The procedure followed was to divide the state into nine roughly equal regions along county lines.[1] In establishing these regions, no attempt was

[1] The counties comprising each region follow: Northwest: Buena Vista, Cherokee, Clay, Dickinson, Emmet, Lyon, O'Brien, Osceola, Palo Alto, Plymouth, Pocahontas, Sioux; North Central: Butler, Cerro Gordo, Floyd, Franklin, Hancock, Humboldt, Kossuth, Mitchell, Winnebago, Worth, Wright; Northeast: Allamakee, Black Hawk, Bremer, Buchanan, Chickasaw, Clayton, Delaware, Dubuque, Fayette, Howard, Winneshiek; West Central: Audubon, Calhoun, Carroll, Crawford, Greene, Guthrie, Harrison, Ida, Monona, Sac, Shelby, Woodbury; Mid-central: Boone, Dallas, Grundy, Hamilton, Hardin, Jasper, Marshall, Polk, Poweshiek, Story, Tama, Webster; East Central: Benton, Cedar, Clinton, Iowa, Jackson, Johnson, Jones, Linn, Muscatine, Scott; Southwest: Adair, Adams, Cass, Fremont, Mills, Montgomery, Page, Potta-

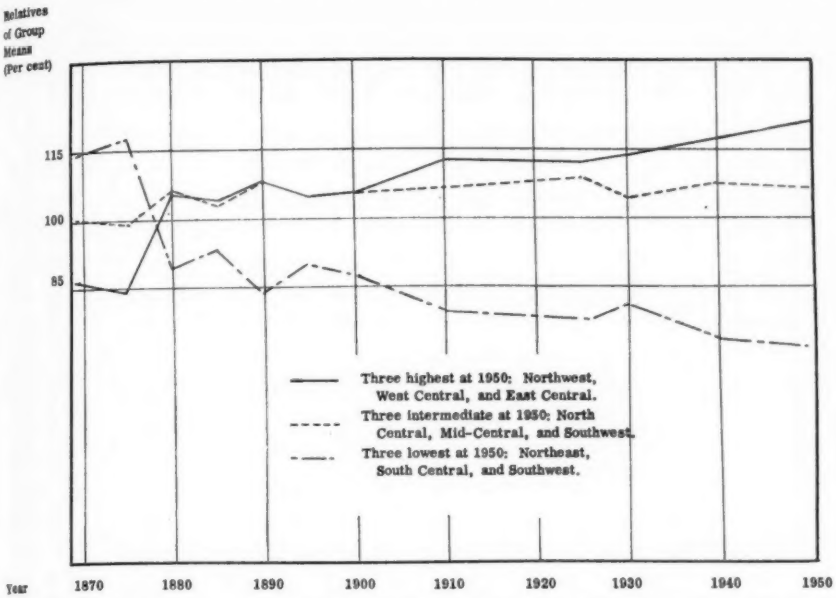

FIGURE 1. RELATIVES OF REGIONAL GROUPINGS OF PER CAPITA INCOMES FROM AGRICULTURE TO FARM WORKERS, IOWA, 1869-1950

made to follow economic area[2] or type-of-farming boundaries. County data were summed to obtain quantities for each region. The material developed is presented in Table 1. It probably represents a longer record at more frequent intervals than would be available for any other state.[3]

A number of techniques were used to measure dispersion in each year of record. These include three statistical measures: (1) relative dispersion (Table 1), (2) coefficient of variation (Table 1), and (3) relatives of regional groupings (Figure 1). Because of the small number of regions involved, no computations of rank correlations were believed necessary; but regional rankings are shown in Table 1. The relatives of regional groupings were derived from the rank order of regions as of 1950, the three lines representing respectively, the three highest, the three intermediate, and the three lowest regions. The arithmetic mean of regional values was used in computing the relatives for each year.

The results clearly indicate the persistence of regional differences in gross incomes over an eighty year period. Care should be used in evaluating year-to-year changes in dollar amounts because of varying defini-

wattamie, Ringgold, Taylor, Union; South Central: Appanoose, Clarke, Decatur, Lucas, Madison, Marion, Monroe, Warren, Wayne; Southeast: Davis, Des Moines, Henry, Jefferson, Keokuk, Lee, Louisa, Mehaska, Van Buren, Wapello, Washington.

[2] Donald J. Bogue, *State Economic Areas* (Washington: Government Printing Office, 1951), p. 2.

[3] U. S. Library of Congress, *State Censuses* (Washington: Government Printing Office, 1948).

TABLE 1. REGIONAL GROSS RETURNS PER MEMBER OF THE AGRICULTURAL LABOR FORCE, IOWA, 1869–1950[a]

Year	Average Gross Product	Region									Relative Dispersion	Coefficient of Variation
		North West	North Central	North East	West Central	Mid-Central	East Central	South West	South Central	South East		
1869	Value	$ 121.46	$ 244.22	$ 320.79	$ 190.15	$ 289.10	$ 395.51	$ 285.56	$ 295.01	$ 324.12	3.26	0.828
	Rank	9	7	3	8	5	1	6	4	2		
1875	Value	267.45	499.74	437.69	472.52	600.31	747.90	664.29	939.58	700.21	3.51	0.946
	Rank	9	6	8	7	5	2	4	1	3		
1880	Value	246.36	331.41	292.80	318.16	332.13	394.35	299.94	223.15	296.05	1.77	0.465
	Rank	8	3	7	4	2	1	5	9	6		
1885	Value	421.21	432.48	470.93	479.68	493.36	537.75	500.22	414.23	408.77	1.32	0.308
	Rank	7	6	5	4	3	1	2	8	9		
1890	Value	374.73	359.08	322.51	341.33	378.38	362.56	341.32	239.49	279.41	1.58	0.394
	Rank	2	4	7	5	1	3	6	9	8		
1895	Value	457.71	529.53	473.99	437.99	440.53	548.28	470.20	345.33	410.42	1.59	0.375
	Rank	5	2	3	7	6	1	4	9	8		
1900	Value	439.13	460.35	417.44	464.70	441.19	464.78	470.65	338.73	388.45	1.39	0.287
	Rank	6	4	7	3	5	2	1	9	8		
1910	Value	1,207.71	1,117.97	1,002.65	1,185.65	1,057.18	1,105.99	1,160.42	656.56	830.03	1.83	0.519
	Rank	1	4	7	2	6	5	3	9	8		
1925	Value	1,633.37	1,461.02	1,078.66	1,465.17	1,361.56	1,166.10	1,329.74	868.40	1,017.68	1.88	0.554
	Rank	1	2	7	3	4	6	5	9	8		
1930	Value	2,369.59	1,945.81	1,570.07	2,261.34	2,036.94	1,965.18	2,094.00	1,482.46	1,627.46	1.60	0.453
	Rank	1	6	8	2	4	5	3	9	7		
1940	Value	2,060.11	1,780.14	1,153.65	1,756.76	1,736.60	1,635.49	1,465.09	987.24	1,253.21	2.09	0.369
	Rank	1	2	8	3	4	5	6	9	7		
1950[b]	Value	7,373.03	6,018.30	4,492.90	6,305.76	5,959.10	6,398.24	5,805.83	2,926.23	4,544.82	2.52	0.230
	Rank	1	4	7	3	5	2	6	9	8		

[a] In general, the gross value of farm products was obtained by summing values of crops harvested or sold, livestock sold, etc. as enumerated by the state or federal censuses. The labor force, for the most part, was derived from the rural farm male population fifteen and over. In many cases this had to be approximated. Whenever possible, a criteria of rural-farm rather than simply rural was used. This involved the subtraction of many small population centers, whose population was presumed to be rural-nonfarm in nature. For a detailed presentation of the method of computation used here see Appendix V of my unpublished Ph.D. dissertation, "Geographic Differentials in Returns to Corn Belt Farmers: 1869–1950," The University of Chicago.

[b] Regional means of county medians of income from both farm and non-farm sources would be for the respective regions: $2,941, $2,843, $2,309, $2,028, $2,746, $2,871, $2,185, $1,944, and $2,300. Computations based upon U. S. Bureau of the Census, *Census of Population: 1950*, Vol. II, Part 15, Chapter B, pp. 122–126.

tions of gross value of farm products and of farm labor force, and because of different bases of enumeration. Rank orders, however, give a clear picture of the relative positions of the various regions over the period indicated. Relatives of regional groupings indicated in Figure 1 summarize the persistent trend as well as changes in position.

The evidence derived from the measures of relative dispersion and of coefficients of variation reveals no consistent narrowing of regional differentials over time as denoted by either measure. Of particular interest is the 1940-1950 decade which reveals an inconsistent finding. Even though relative dispersion has increased and the spread of regional relatives has widened, the coefficient of variation indicates decreasing regional variation. The decrease in the coefficient of variation during a decade of full employment in urban centers gives statistical vindication to the idea that full employment in the non-farm sector is vital to the solution of differentials in incomes by geographical regions. Because of the inconsistency of the statistical results in the most recent decade and the still considerable disparity of regional incomes, the results of further investigation of a cross-sectional nature are shown below.

Gross vs. Net Income

The hypothesis that regional variations in average agricultural incomes are caused in whole or in part by the reporting of income on a gross rather than a net basis was tested using data from the 1940 census.[4] Gross value of farm products sold, traded, or used was diminished by expenses reported by counties from direct enumeration by the census. These included approximately 46 per cent of total expenses and consisted of the categories of feed purchased, livestock purchased, cost of commercial fertilizers and liming materials, and expenditures for hired labor. Most of the remaining expense data were taken from a BAE study[5] containing estimates of aggregate state totals. These data are capable of being allocated regionally according to county census enumerations of capital values or other criteria related to the expense considered. Approximately 5 per cent of total expenses was allocated according to regional values of farm buildings after adjustment for dwellings. This allocation included the depreciation of buildings and the cost of fire, wind, and hail insurance. The regional values of land and farm buildings, after adjustment for dwellings, were used to allocate payments of net rent to non-farm landlords and taxes on real property. Approximately 17 per cent of total

[4] U. S. Bureau of the Census, *Sixteenth Census of the United States: 1940. Agriculture* (Washington: Government Printing Office, 1942-3).

[5] U. S. Bureau of Agricultural Economics, *Income Parity for Agriculture*, Part VI, *State Estimates of Income and Production Expenses*, Section 1, *Net Income and Production Expenses of Farm Operators by States. Calendar Years 1929, 1930-44.* (Washington: U. S. Bureau of Agricultural Economics, 1945).

expenses was distributed in this manner. Regional values of farm implements and machinery were used to allocate estimated depreciation of implements and machinery (approximately 11 per cent of total). The sum of values of farm implements and machinery and value of livestock on farms was taken as a regional index to distribute cost of short term interest and taxes on personal property (about 4 per cent of total). All the remaining estimates were similarly distributed.

TABLE 2. AVERAGE GROSS AND NET RETURNS TO UNADJUSTED RURAL-FARM POPULATION AND TO MAN-EQUIVALENT FARM WORKERS AFTER ADJUSTMENT FOR NON-FARM WORK, BY REGIONS, IOWA, 1940[a]

Region	Per Capita			Per Man-equivalent Farm Worker after Adjustment for Non-Farm Work		
	Gross Income	Net Income from All Farm-Owned Capital, Labor and Management	Net Income from All Farm Labor and Management	Gross Income	Net Income from All Farm-Owned Capital, Labor and Management	Net Income from All Farm Labor and Management
North West	$870.08	$390.40	$291.95	$2,485.36	$1,115.17	$833.95
North Central	767.35	355.98	272.06	2,202.60	1,021.82	780.92
North East	492.78	221.19	153.81	1,433.06	643.26	447.30
West Central	756.00	340.34	258.31	2,174.90	979.11	743.12
Mid-Central	769.19	357.61	266.21	2,308.99	1,073.50	799.10
East Central	722.73	273.00	160.35	2,089.68	789.33	463.63
South West	653.57	263.72	176.00	1,970.96	795.28	530.76
South Central	433.86	206.03	152.93	1,361.17	646.40	479.79
South East	538.16	240.48	173.40	1,681.16	751.24	541.68

[a] Compiled from U. S. Bureau of the Census, *Sixteenth Census of the United States: 1940* (Washington: Government Printing Office, 1942) *Agriculture*, Vol. II, Part 1, pp. 554–563 and *Population*, Vol. II, Part 2, pp. 921–926, with adjustments for Government payments and the adjustment for man-equivalents described in footnote (8).

The results of these estimates, computed on both a per capita and a per man-equivalent basis, are shown in Table 2. The statistical measures shown in Table 3 reflect an increase rather than a decrease in dispersion if the income calculations are computed on a net rather than a gross basis. This is true even after the measures of farm labor force are refined to adjust for age-sex differences, off-farm work, and non-operator status. The reporting of incomes on a net basis apparently would not reduce the differences in income among the various regions of Iowa in the year 1940.

Refinement of Labor Force Data

The second cross-sectional hypothesis tested was that the effect of non-farm employment and the regional age-sex distributions increased the dispersion of regional average incomes.

The amount of non-farm work performed by farm operators in each region was obtained from U. S. Census enumeration of the number of

days worked in non-farm work by farm operators.[6] These figures were used to estimate the regional amount of non-farm work by non-operator farm residents.

The age-sex classification of rural farm residents was derived from the U. S. Census of Population[7] and was adjusted by man-equivalent ratios[8]

TABLE 3. COEFFICIENTS OF VARIATION AND RELATIVE DISPERSIONS OF GROSS AND NET RETURNS TO VARIOUS FARM LABOR UNITS, IOWA, 1940

Type of Farm Labor Unit	Gross Income		Net Returns to Farm-Owned or Family-Owned Capital, Labor and Management		Net Returns to Farm or Family Labor and Management	
	Relative Dispersion	Coefficient of Variation	Relative Dispersion	Coefficient of Variation	Relative Dispersion	Coefficient of Variation
Per Capita	2.01[a]	0.626[a]	1.89	0.650	1.82	0.783
Per Rural-Farm Resident Adjusted for Non-Farm Work	1.97	0.613	1.86	0.636	1.88	0.767
Per Man-Equivalent Unit Adjusted for Non-Farm Work	1.83	0.564	1.72[b]	0.592[b]	1.86[b]	0.728[b]
Per Farm Operator	2.31	0.715	2.09	0.758	2.37	0.951
Per Farm Operator Adjusted for Non-Farm Work	2.20	0.682	1.99	0.723	2.30	0.918
Per Man-Equivalent Farm Operator Adjusted for Non-Farm Work	2.07	0.652	1.87	0.693	2.23	0.890

[a] If the value of government payments is excluded from gross income, results would be 2.06 and 0.633 respectively.

[b] If the productivity of female workers is increased from 10 per cent of male productivities to 25 percent, results would be 1.75, 0.597, 1.72 and 0.734 respectively.

for each age and sex group. The ratios used may not apply exactly to Iowa agriculture outside of the dairy areas. The man-equivalent ratios used appear, however, to be more flexible than those used in some farm income studies[9] and to have greater empirical justification than those found in others.[10]

[6] U. S. Bureau of the Census, *op. cit.*, Vol. I, Part 2, pp. 190-193.

[7] *Ibid., Population*, Vol. II, Part 2, pp. 921-926.

[8] In this case the ratios used were derived from the work by Erven J. Long and Kenneth H. Parsons, *How Family Labor Affects Wisconsin Farming*, Research Bulletin 167 (Madison: University of Wisconsin Agricultural Experiment Station, 1950). The ratios for farm males were taken as follows: Age 0-10, .00; 10-14, .25; 15-19, .75; 20-39, 1.00; 40-44, .90; 45-49, .85; 50-54, .78; 55-59, .70; 60-64, .60; 65-69, .50; 70-74, .38; 75 and over, .22. Ratios applied to females were computed at 10 per cent of the ratios shown above to adjust for time spent in household activities and reduced efficiency in certain farm work.

[9] For instance, see: Louis J. Ducoff and Margaret Jarman Hagood, *Differentials in Productivity and in Farm Income of Agricultural Workers by Size of Enterprise and by Regions* (Washington: U. S. Bureau of Agricultural Economics, 1944), p. 36.

[10] Selz C. Mayo, *et al., Farm Labor Problems*, Bulletin 344 Raleigh: North Carolina Agricultural Experiment Station, 1944, p. 23.

Results of the refinements of farm labor force data, computed on both a gross and a net basis, are presented in Table 2. Statistical measures shown in Table 3 indicate that some portion of the regional dispersion in income can be explained by differences in the amount of non-farm work and in age-sex composition from region to region.

A further hypothesis tested was that dispersion of average regional farm operator income was less than average income to all farm workers. The actual income figures are not presented, but the statistical measures shown in Table 3 indicate that averages of regional net income to farm operators, after adjustment for farm worker cash wages and perquisites, show no appreciable change in the degree of dispersion.

Effect of Asset Ownership and Non-farm Income

The last hypothesis tested with 1940 data was that regional differences in income can be explained by the differences in ownership of farm assets. The value of farm-owned capital was derived from census enumeration and an interest allowance imputed on the basis of regional means of median interest rates by counties as reported in the 1940 Census.[11] The unexpected result of subtraction of an imputed return to farm-owned capital, using values given in the U. S. enumeration, is to increase dispersion. Differences in ownership of production factors apparently serve to conceal differences in returns to the labor factor from region to region. It is possible, however, that enumerated capital values, particularly for land, may be overstated in some regions relative to others. This point probably should be investigated further.

Median incomes of rural farm families and unrelated individuals can be computed by counties from 1950 census enumerations for total, urban, and rural non-farm categories.[12] The definition of income used[13] does not include certain capital gains and income in kind but is a much broader conception of income than any used above. For comparative purposes, these county median incomes were averaged by regions to produce the amounts shown in a footnote to Table 1. These data possess a relative dispersion of 1.51 and a coefficient of variation of .40, indicating that even though extreme values have tended to become closer with the inclusion of income from non-farm sources, dispersion as measured by the coefficient of variation appears to have increased, perhaps implying regional income differences outside the agricultural sector. None of the cross-sectional tests, with the possible exception of regional differences in age

[11] U. S. Bureau of the Census, *op. cit., Agriculture,* Vol. II, Part 1, pp. 544-553.

[12] U. S. Bureau of the Census, *U. S. Census of Population: 1950* (Washington: Government Printing Office, 1952), Vol. II, Part 15, Chapter B, pp. 122-126.

[13] *Ibid.,* pp. xiv.

and sex composition, tends to explain any appreciable portion of regional differentials.

The findings with respect to gross versus net incomes by regions offer support for the thesis[14] that gross income reporting tends to obscure regional differences in income. For the year indicated, Iowa regional incomes show less dispersion when relative dispersion is used as a measure. On the other hand, the coefficient of variation indicates increased dispersion resulted from reporting of incomes on a net basis. Recognition must be given, however, to the fact that, because of the incidence of ownership of productive factors, there is no necessary relationship between gross income and net income. Net income, primarily an accounting rather than an economic concept, takes no account of rewards to assets owned by the farm firm or to unpaid family labor and management. The residual reward to the farm firm consists of varying proportions of rewards to owned assets, to labor, and to management; and imputation of a return to farm owned assets attempts to measure returns to labor and entrepreneurship.

Analysis of Time Series Data

Scrutiny of the data gives no support to the hypothesis that pioneer communities have income levels of virtual equality.[15] Data for still earlier years would be required, however, for an adequate test of this hypothesis.

An explanation of the curious shifting of position of the present day poorest region from the earlier richest region undoubtedly would throw some light upon the process of economic growth. At this stage of his studies the writer is led to believe that at least an important part of the explanation lies in the capitalization of expected income flows from land. Assume that the rate of disinvestment, in terms of the dollar value of crops taken off the land after payments to other factors, differs from region to region. If the potential difference of soil-exhaustion or other disinvestment among regions is unknown, as it is quite likely to be, one region will suffer a greater capital loss than another. If capital movements are imperfect, a once prosperous region would lose its superior income position.

The process may be similar if investment in land, defined broadly, remains constant or is being increased, provided that the potential change has not been anticipated in the capitalized value of land. In a context of technological or institutional change some land is more readily adaptable

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[14] Carter Goodrich, Bushrod W. Allin, and Marion Hayes, *Migration and Planes of Living, 1920-1934* (Philadelphia: University of Pennsylvania Press, 1935), p. 13.

[15] T. W. Schultz, "Reflections on Poverty Within Agriculture," *Journal of Political Economy*, LVIII (February 1950), p. 2.

to change and, other things being equal, will tend to become more valuable. Thus the productivity of land in the northeastern and north-central parts of Iowa increased because of the capital investment in drainage and the adaptation of civil institutions to the formation of drainage districts. The land in south-central Iowa (and to a certain extent in northeastern Iowa) did not lend itself so readily to this type of capital investment. Rather there was a disinvestment of timber resources and also of soil resources. In this same context, the response of market values of land to anticipated railroad construction may have inaccurately reflected future income flows so as to cause regional differences in cost which were essentially unrelated to actual regional differences in income flows. In a context of imperfect in-movement of capital, this problem of capitalization values may well explain subsequent disparate incomes, particularly when additional capital may be required to adjust to dynamic conditions. Thus a farmer who uses resources to buy over-priced land may be prevented from making the capital investments necessary for adjustment to changed technological, labor, or other conditions. The same would be true for a farm region to the extent that exchanges of land are not simply internal transfers within the agricultural sector of a particular region. In either case, the failure to adapt to dynamic change may either depress incomes or prevent a rise concomitant with those of neighboring regions.

Connected with the problems of disinvestment of land are considerations of reversibility. Suppose that disinvestment of land resources took place throughout Iowa and that the rates of disinvestment were the same in each district as those related to dollar volume of crops after payment to other factors. If the disinvestment in land resources in today's poorer districts were less reversible, the change in relative position could be explained to some degree by reinvestment costs.

Because capitalized values of land are not based on anticipated change growing out of technological and institutional development, perhaps the existing capital values of land should be regarded as inferior to rental values in attempting to measure rewards to farm owners of land. Possibly regional differences in returns to labor and management factors as described here would have shown less disparity if this were done.

Even under conditions of imperfect mobility of capital resources, however, perfect mobility of labor would equalize returns to labor from one region to another. This assumes that the agricultural labor force is homogeneous from region to region. Consideration of hypotheses relating to regional differences in education, religion, race, or ethnic group in this study was limited to a rather cursory examination, which appeared to indicate that these differences were not closely related to regional income

differences. Of course, more definitive examination could be made of these influences.

More important, in the opinion of the author, would be an examination of the relative mobility of population by regions viewed in connection (a) with some measure of natural increase and (b) with the level of employment outside the agricultural sector. Although no effort was made to scrutinize these possibilities, population pyramids constructed for each region[16] for 1940 reveal a pattern of net outmigration for both sexes once the young adult ages are reached, and apparently a cessation of net outmigration after age twenty-five. This pattern conforms to the general pattern of outmigration from agriculture in the United States.[17] Inspection of the population pyramids, however, does not offer a satisfactory method of determining differential mobility by regions.

Emphasis must also be placed upon the aspect of *net* population movement. Even though there is considerable outmigration from a given region, inflow from regions of still lower average incomes may serve to prevent a disappearance of regional income differences. Relative mobility in response to employment opportunities outside agriculture can be related to cyclical considerations by analysis from time series data. This problem can be approached from the cross-sectional point of view by relating incomes in the agricultural sector to incomes in the urban and rural-nonfarm sectors. The writer hopes to publish a study of the latter relationship for the North Central States in the near future.

Summary

Summary of the time series aspect of this study will be found in Table 1 and Figure 1. The summary indicates the existence of a persistent regional difference in returns to Iowa farmers for a long period. Moreover, long-run adjustments cannot unequivocably be said to be in the direction of income equalization. Cross-sectional findings, based on 1940 data, are summarized in Tables 2 and 3. Regional income disparity cannot be explained to any appreciable degree by reporting on a gross rather than a net basis. Adjustments for regional differences in age-sex distribution and non-farm work explain only a small proportion of income disparity. Computation of returns to farm operators as against all farm residents creates increased dispersion. Dispersion is further emphasized by the imputation of a return to family-owned farm capital. Using 1950 data, the income disparity found among regions in average incomes to rural farm residents

[16] See my unpublished Ph.D. dissertation, "Geographical Differentials in Returns to Corn Belt Farmers: 1869-1950," University of Chicago, 1953, p. 41.

[17] Dorothy Swaine Thomas, *Research Memorandum on Migration Differentials* (New York: Social Science Research Council, 1938), pp. 11, 162.

from both farm and non-farm sources is greater than that based on gross income per farm resident from farm sources alone. This is indicated by respective coefficients of variation of 0.40 and 0.23.

Extension of these cross-sectional findings to wider areas or over a longer time period involves loss of detail. The general findings undoubtedly can be applied, however, in both the geographic and time dimensions. Further verification of such extension is called for. In addition, it is desirable to have specific investigation (1) of the relationship of farm and non-farm incomes, (2) of labor mobility, including gross in- and out-migration, and (3) of the imputed return to farm-owned capital including (a) the problem of enumerated values of land and (b) the consideration of the rental method of evaluating returns to land.

NOTES

PROBLEM OF THE LOW-INCOME FARMERS*

THIS is in answer to your request of June 9th for comments, within sixty days, on the problems of our low-income farmers and particularly on the research and extension phases of it. You are surely right that price supports mean very little to our low-income farmers. I will add that helping them will mean more to the future of our country by far, and its standing in other countries, than raising further the income of our prosperous farmers. Many times I have been asked in recent years by visitors from abroad, "Surely you have some low-income farmers somewhere in your country—what are you doing to improve their lot?"

We are very fortunate in the United States in that we have already had enough experience in dealing with the problem of the low-income farmers, albeit on a small scale, and have the institutions needed, so that about all we need to do is to have the will to go ahead.

The truth of this statement is most clearly obvious in the case of the families that simply do not have enough land even though it were developed to the optimum point. The Farmers' Home Administration has authorization to make loans to help such families. But the FHA has very limited funds and has been limited by the language of the Act. The effects are much more important than is commonly understood. In the New England states alone, 6 to 8 million acres of land went out of agricultural use between 1850 and 1920; most of which should have been added to nearby farms. New England had too many farms in 1850. The smaller ones did not make a decent living for the families. The sons took jobs in the cities and nobody took over when the old folks passed on. Some of these farms were added to other farms, but by no means enough of them. This same situation has now developed in the South. We are going to need this land in agriculture in the coming decades because of our rapidly growing population. Our new-land frontier is virtually gone, and as time goes on it will become more costly to restore this land to agriculture.

Also, if there was someone nearby to whom farmers with low incomes could sell their farms, more of them would sell out and find other occupations.

The process of abandonment has been changed somewhat in recent decades. More of the low-income farmers, in the South especially, have found jobs in factories or other city jobs and are still living on their land but neglecting it and letting it grow up to trees. Or it may be so-

* A letter to Secretary of Agriculture, Ezra Taft Benson, from Professor John D. Black, August 2, 1954.

called part-time farmers who are doing the same thing. The automobile has made this difference.

Usually it is not enough simply to get more land for families with too little land. Commonly the more land that can be made available has been allowed to run down and needs rehabilitating. The land the families already have may also need treatment to increase its productivity.

This points to the second category of low-income farmers—those who have enough land, but have not improved it up to the level now most advantageous, or who do not have the equipment or livestock or perhaps buildings to farm it as it should be. Why so? In many cases the reason is they can't get the needed credit, or at least get it under suitable terms. Credit is still commonly based on the property security that can be furnished rather than on the increased productivity that is being financed. The FHA makes loans for such purposes and under suitable terms, but again has only limited funds and personnel. The PCA's for the most part make only annual loans with prospect of renewal if everything goes reasonably well.

But making more funds available for purchasing and improving additional land, or increasing the productivity of present farms, will not be enough. There is needed in addition an extension program that shows to the farm families the possibilities of getting such increased incomes in the two ways indicated, and then provides personnel to sit down with the families on low-income farms and work out plans for their development, and enlargement if need be, and also plans for any borrowings required.

For the first part of this, the showing of the possibilities, I would recommend the singling out of good examples of such farms—examples that[1] are much like those that commonly occur in the area—and making a careful analysis of these, testing by budget analysis the different possible alternative crop-and-livestock combinations, the land improvement programs, pasture and feeding programs, fertilizer programs, machinery programs, etc., to see which promises best, and the investment for each, to see which offers the best combination of increase in income and feasibility. I would do two things with the results of such analysis: one, talk them over in detail with small groups of low-income farmers, and second, get some of the farms to operating on the basis of the plans chosen, these farms to serve more or less as demonstration farms.

Extending such an undertaking to low-income families generally will require increasing the extension staffs considerably. In most counties there really ought to be one farm-management and one home-management specialist devoting their full time to helping farmers and their

[1] Speaking in my usual way, I would call these "modal-type" low-income farms.

families in home-and-farm planning, and these should give at least half their time to the lower-income farm families in much of the United States. It is my understanding that a start in this direction is to be made in the year ahead. Progress will be tremendously handicapped by the lack of trained personnel unless training schools are organized on a wide scale. The extension services should not, however, carry the full burden of such an undertaking. The soil conservation districts should provide maps for the farms and the land to be purchased, these maps showing field boundaries, vegetative cover, slopes, stoniness, erosion, soil types, and land-use capability classification. They should collaborate with the farm management specialists in choice of rotations and land use for the different fields and in developing the erosion-control and other conservation features of such land-use plans. At a later stage they should help with the laying out of terrace and contour lines, grassed waterways, etc. For farms that will clearly need to be financed by the FHA, the nearest local FHA representative can also collaborate in so far as he has time.

For how many farm-and-home plans can a farm-and-home management team of two expect to help work out plans in one year in a county with the collaboration just described? Probably no more than twenty the first year. There is so much to learn about how to do it and so much planning data to assemble. But in the second year the number should be doubled. When the point has been reached where group planning can handle a large part of it, at least a hundred a year. In the meantime, however, the families with plans already made will be asking for follow-up help. This should be handled in group meetings so far as possible. By the time five hundred farms in a country have been planned, the pattern of improved farming will have been so well established that the rest will not require anywhere nearly so much individual attention. And when that time comes, much more of the effort of the extension team can be devoted to year-to-year adjustments called for by the outlook situation, new technology, etc.

The farm plans developed for many of these farm operating units should include provision for development of the woodlands. Especially is this true in the South and East. Additional land acquired is very likely to include some woodland. Improvement cuttings are likely to yield some additional income at the time, and the work can be done in otherwise idle weeks. In as short a space as five to ten years in some woodlands the improvement cuttings will begin to add something to income. In the South, even tree plantings begin to add some returns in fifteen years. In the meantime, the farms are increasing in value because of the woodland improvements.

Woodland planning will need at least the guidance of extension spe-

cialists in forestry. This can be provided by using some of the new extension funds to assign a specialist to a group of counties, or by increasing the number of farm foresters, or by some combination of the two.

I have suggested elsewhere—for example, in the N.P.A. report on "Federal-State-Local Relations in Agriculture"—that a county committee, made up partly of local representatives of the agencies named and partly of farmers and home-makers, be set up to give general guidance to such a planning program and insure good cooperation of the different agencies.

Nothing has been said in the foregoing about tenants and croppers as distinguished from owner-operators. There is, of course, the Jones-Bankhead tenant-purchase program to help those ready to become owner-operators. It was wise to proceed slowly with this program at the start, but it can now be stepped up safely and considerably, except in periods when land prices are rising too fast.

On the whole, however, there is more need in the United States for leasing systems that will give a tenant a chance to make a good income by improving his farming than there is for helping more tenants to become owners. This is possible, however, only if the farm enterprise as a whole becomes more productive, and this is not possible without the participation of the landlord. Some careful analysis of this problem, followed by some pilot operations in carefully selected areas, seems to be urgently called for. These operations should be of the nature of planning with the landlord and tenant jointly, the plans to call for borrowing by the tenant, and by the landlord if need be, to finance the greater productivity. The leasing arrangements to go with these must protect the tenant's contribution to the improvements.

Something needs to be said about a few other groups. One of these is the part-time farmers. All of them by no means are in the low-income bracket. In New England in the 1940's, the combined incomes from farm and non-farm sources of this group averaged as high as those of the full-time farmers. If their incomes are low in some parts of the United States, it is partly due to the low earnings of these groups at their non-farm jobs. In general, this group is a difficult one to help because of the uncertainty of their status. One cannot be sure how soon they may reduce their farming operations and become nearly full-time urban workers. Nevertheless, such families have as much right to public assistance as any, and their cases need to be examined in turn. Credit for such families will need to be based more on security and less on the increased productivity being financed.

Probably the largest group of low-income farm families in most localities is composed of families of older people and others who are either not in condition to undertake improvements or expansion of their farming

operations, or who have not enough interest in them to warrant public aid of the kind I have outlined.

Still another group is made up of those people who do not have the ability to carry out farm plans or the stability (or integrity) to warrant taking a chance on them. Many of these people will be found among the groups applying for assistance. This makes careful screening of applicants necessary.

There remains the question of who is to furnish the credit needed. Once the practice of making operating and borrowing plans for individual farms has become somewhat established, it can be expected that the regular commercial banks will find it good business to make part of the loans called for in these plans, especially the short-term and intermediate-term loans. By all means the necessary changes should be made so that the insured loan program can get going again. Also, it can be hoped that the Farm Credit Administration will see fit to have its PCA's handle more intermediate-term loans, sometimes in combination with annual loans, and to make them as full-fledged intermediate-term loans. But there still will be need for a larger volume of direct FHA loans than now. In the next five years or so, while the planning program is getting established, the volume will need to be very much larger if significant headway is going to be made in raising the incomes of the low-income farm families.

This raises the question as to how hard such a program should be pushed. The primary answer is, never in desperation at any stage. The first three years should be devoted to learning how to do it. Nevertheless, the pressure should be enough so that at the end of ten years, the problem will have been mastered. What will be required from then on will be mainly a continuation of what has been developed.

What about the surplus population of the South as a phase of the low-income problem? The most important part of this is to keep the channels of communication and recruitment wide open so that migration to the North and West can go on freely. I am not sure that they are now as wide open as they should be.

Also, we should not be importing labor from Mexico so long as we have a surplus in the South; but the present provision for living arrangements in the migrant labor areas is so inadequate that we cannot expect these areas to provide much of a labor outlet. It is high time that the types of agriculture depending on migrant labor bear the full social cost of such labor. I realize this is a very touchy subject, on which men like George Wilson of the California A.F.B.F. have strong feelings. Still, somebody needs to speak out the truth on occasion.

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FARM TENANCY AND COSTS OF BORROWING*

THE purpose of this note is to present a hypothesis concerning credit-tenure relationships. We deal with the relationship between farm tenancy and the structure of borrowing costs confronting agricultural entrepreneurs.

Such relationships have long been a matter of question. On one hand intuition suggests a positive correlation, *ceteris paribus*, between tenancy levels and interest rates for farm mortgage loans. Admittedly the relationship may be weak, and other forces more important in determining the level of tenancy.[1] Nonetheless it seems unreasonable to dispute the proposition that, when farmers have to pay more for enjoying the ownership variety of land tenure they will be less inclined toward ownership. On this basis, and on the assumption that farm ownership is an eminently desirable social goal, liberalization of farm mortgage credit has been an important part of our national monetary policy.

On the other hand empirical tests have not provided much support for the idea that there is a strong causal relationship between long-term agricultural money rates and farm tenancy. This raises serious questions about the policies based on the presumption of such a relationship. Either the partial regression of tenancy on mortgage interest rates is not significantly different from zero, or due to inadequacies of data none of the empirical tests has any real meaning. Both arguments are appealing; each for a different reason.

There is a third possibility, however, to be explored. This is that the intuitive proposition is somewhat misleading due to its failure to spell out the meaning of the *ceteris paribus* assumption. To show this, we first make the usual (if ordinarily implicit) assumptions: (1) Tenure choice by farmers is an economic decision, *i.e.*, involves a choice among alternatives according to some criterion for maximization. (2) This criterion typically includes profitability. (3) Land, other factors in agricultural production, and the different varieties of money capital are not in general free goods.

If we use as an assumption the statement of Schultz and others that money capital is rationed in such a way as to force farmers with limited resources of their own to choose between borrowing for land purchase and borrowing for the other perquisites of agricultural production,[2] we quickly arrive at the theorem that, for a given state of liquidity, capital

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* This note is a by-product of a broader study of credit-tenure relationships conducted by the National Bureau of Economic Research. The computations in the writer's phase of the study were done by the Bureau of Business and Economic Research, the University of California at Los Angeles.

[1] See, for example, Donald Horton, "Adaptation of the Farm Capital Structure to Uncertainty," *This Journal*, Vol. 31, Jan. 1949, pp. 76-101.

[2] Cf. Theodore W. Schultz, *Production and Welfare of Agriculture*, New York: The Macmillan Company, 1949, Chapter 12.

and rental costs, and expectations, tenancy will vary as the costs of borrowing for land purchase vary *relative to* the costs of borrowing for purchase of the other perquisites of agricultural production.

This theorem is of course quite different in its implications from the intuitive proposition. The hypothesis to be tested is that the level of tenancy, insofar as it is affected by costs of borrowing, is dependent on relations among these costs, rather than on absolute movements in the cost of any particular kind of credit.

Some rough tests of the hypothesis were made by the writer on a state basis for the period 1920-1950, using census and other published data.[3] As should be expected the hypothesis yielded more positive results in states such as Arkansas and Iowa, among the states in the sample, where tenancy has been relatively important quantitatively and presumably a feasible tenure alternative.

In the full-dress testing of the hypothesis, the writer believes it would be desirable to obtain the necessary data through sampling, rather than to rely on census and other reported aggregate figures. Census data lack homogeneity and have not proved satisfactory in attempts to test the hypothesis. Definitions of the relevant variables and methods of estimating variables relative to tenure questions have changed considerably from time to time. Cross-sectional analysis on a state or county basis would be satisfactory only if it were possible to adjust for such unquantitative variables as tenure traditions and attitudes, lender policies, and type of farming. Differences in such factors are known to exist and are likely to be important in choices made by farmers relative to tenure. A further problem with currently available data in aggregate form is the lack of detail, geographic and otherwise, of some of the important series. County data on tenure conditons, for example, are not usable without some seemingly dubious transformations with respect to money rates.

In a study of the hypothesis based on a carefully selected sample, some of these problems might be met through the institution of appropriate procedures for selecting farm entrepreneurial units as well as by means of careful estimating techniques. Although this would be a relatively expensive method of investigation, especially if conducted on any appreciable scale, the possible implications of the hypothesis for public policy are important enough to warrant greater expenditures than have been made available.

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[3] Interest rate data are available in many USDA publications and other sources such as H. T. Lingard and W. O. Brown, *Interest Charges Payable on Farm Indebtedness in the United States, 1910-1940*, U. S. Department of Agriculture, Bureau of Agricultural Economics, 1942.

PROSPECTING A DRY HOLE

ECONOMICS doesn't have to be the dismal, dry and uninteresting subject that many economists make it. Agricultural economists sometimes envy the extension specialists in crops, soils, animal husbandry and other more tangible subjects. But when a speaker is needed for a service club-farmers dinner, a farm organization annual meeting, or wherever there is need for a subject that is of interest to everyone, who gets the call? A large share of the time it's the agricultural economist.

People want to know why the farmer gets only 45 cents of the consumer's food dollar, why our type of enterprise system produces a high level of living, what can be done about inflation or depression, and what's wrong with our farm price program. Interest in these subjects extends beyond agriculture. Non-farm people are interested as consumers and as taxpayers.

The really difficult job is getting an audience. From meetings where economic subjects are discussed, they stay away by the thousands. Each person has many alternative uses for his time. Most of the alternatives are more attractive than a lesson in economics even if the program is especially good. But when someone provides a "captive" audience, the least the economist can do is to make an impression that will create other opportunities as well as stimulate the current audience to absorb a little education in the process.

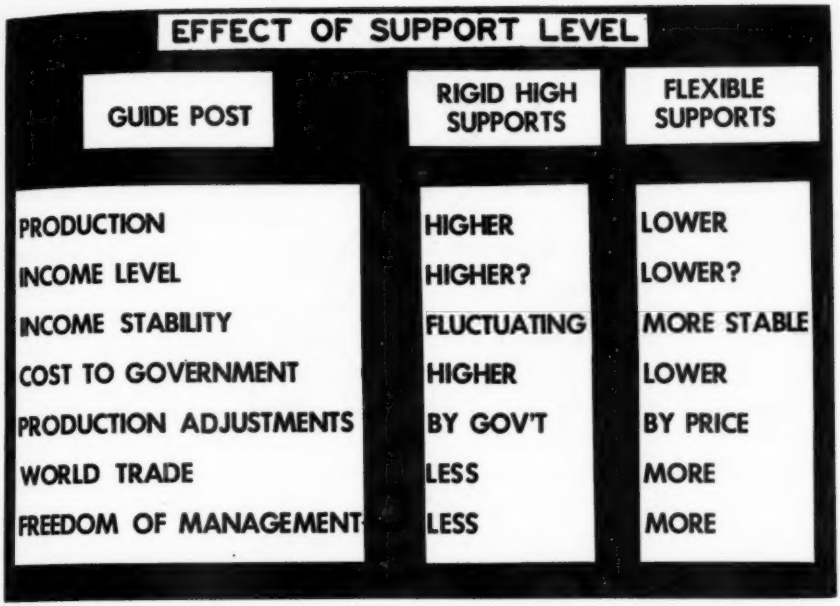
A timely story, joke, or humorous illustration that has some relation to the point of discussion helps to lighten the load for the audience. They won't object to being educated if a little entertainment is tied into the package. Don't overdo it! The entertainment should be incidental.

A little less money spent on travel and a little more for visual aids will help to make our work more effective. Most of our audiences expect to see a set of charts when an economist talks. In fact we turn so many charts, our listeners get a little weary of the process. A flannel graph, blackboard, or some other gadget lends a little variety. In fact, a few good "props" will help to "cover up" some of our mediocre speeches, and they certainly will enhance the effectiveness of the occasional good ones.

What a difference spot lights will make! Most meeting halls are poorly lighted. Even if the lighting is fairly adequate, a little touch of glamour is added by focusing a bright spot light where the attention is wanted.

Most meeting places are void of lecterns. If we use notes we must hold them in our hand or place them below us on a flat table so we are continually bobbing down and up. Since we need a box anyway to carry the lights, extension cord, eraser, chalk, and other useful equipment, one can just as well be made with a sloping lid and a rope handle.

For purposes of illustration I will describe some tools and techniques



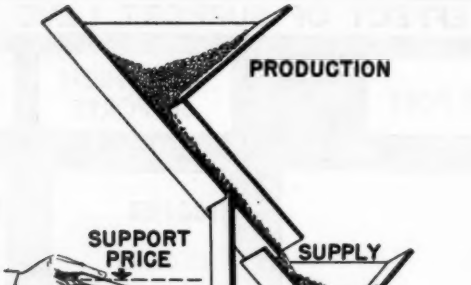
used in Michigan in meetings where price programs in agriculture is the subject for discussion. This is not to say that we are satisfied that these are the best, but only indicate that we are continually experimenting in the hope that presentations will be more effective.

These particular discussions are built around an eight-page discussion pamphlet, No. 19 in our series of *Open Meetings on Agricultural Policy*, "A Farm Price Program—What Kind Should It Be?" Copies are made available to those who request them.

In most cases time is limited to a period of 40 minutes to one hour. Only a few minutes can be devoted to a discussion of "the farm problem" and perhaps an explanation of "parity." The "meat" of the discussion is a comparison of "flexible" and "high rigid" price support levels and their probable consequences.

The spot light is flashed on a fiber board chart (see figure) measuring about 30″ × 40″ and mounted on an easel. To permit easier handling and packing in a canvas bag, the chart is made in two sections. The supports at top and bottom are grooved to hold the sections in a rigid position. The information on the chart is hardly more than some key words to cue the speaker.

In order to dramatize a little and get some action into an inanimate subject, a mechanical gadget is used to demonstrate the impact of price on production and consumption (see drawing). This demonstrates how the free market price equilibrates supply and demand and finally how a



support price tends to "shut off" consumption, stimulate production, and create burdensome surpluses. The audience is impressed. The comments lead me to believe that they get the point and remember the lesson better than if it was just "talked" or a diagram was drawn on a chalk board.

When time is available in a half-day or all-day (10 A.M. to 3 P.M.) meeting with farm organization discussion leaders or home economics club leaders, additional "gimmicks" can be used. A set of charts, of course; but most of them are held in reserve to help answer questions. A chalk board to demonstrate parity and methods of support. To break the monotony and to obtain audience participation, an hour of the time is used for "huddle" discussions. A member of the group of five to ten people reports on which of several alternative solutions they selected as most desirable and the reasons for their action. Enough copies of the discussion pamphlet are available so that leaders may take a supply back to the local discussion group.

In many ways education in public affairs is still an experiment. But this much we have learned—the people are interested in a discussion of controversial issues. If the educators emphasize facts and alternative solutions and their probable consequences and avoid taking sides, there is little danger that the specialist and his institution will be criticized for his effort to help citizens make more intelligent decisions in public affairs.

ARTHUR MAUCH

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HUTTON AND THORNE ON ISOCLINES: A REPLY*

HUTTON and Thorne's worry arises mainly because they have not considered the nature of isocline maps. Fertilizer isocline maps, along with the marginal quantities with which they are associated, are the foundation for fertilizer recommendation and use. Unfortunately little is known about their nature. Von Leibig offered early hypotheses supposing that they reduce to a single line; but we find little research devoted to establishing their nature. Our work is of a methodological nature. We refrain from using the data of a single year on a single soil type and crop to generalize to all fertilizer use situations. Hutton and Thorne seem to feel that our results can be so used. We believe more similar experiments should be conducted prior to these steps. The points suggested by them, and others, were known previously by us and are given in a longer manuscript.[1] Space limitations restricted our article to bare methodological applications. Our procedure is the correct application of appropriate economic principle and empirical method for maximizing profits. As we knew previously, the gain or loss from using the "exact principle," as compared with "rule of thumb principle," depends on the nature of the isocline and isoyield maps and the level of fertilization to be used.

In figure 1 we present isoclines, based on actual production surface estimates, for corn and alfalfa respectively. An isocline connects all points of the same slope (i.e. equal substitution rates) on successive isoquants. The isocline conforming to a particular price ratio also is an expansion path tracing combinations of nutrients that give least cost yields. The family of isoclines converge at the point of maximum yield. (Nutrients are limitational at the convergence point; substitution is impossible.) If an isocline conforming to a particular price ratio is nearly straight, an increase in nutrients by a fixed proportion is nearly consistent with the least-cost use of nutrients. If the isocline "bends sharply," a fixed-ratio fertilizer increase will not give the most economic nutrient combinations. While little is known about them, isocline maps can take on many distinct forms. They can be established only by basic experiments. (If Hutton and Thorne have prior knowledge of their nature for other Iowa crops and soil types, we hope that they will unveil the secret. Presumably one would have this information if he knew the one variable curve to predict

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* Journal Paper J-2722 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1189. See R. F. Hutton and D. W. Thorne, "Review Notes on the Heady-Pesek Fertilizer Production Surface," *This Journal*, Vol. XXXVII, Feb. 1955, pp. 117-119. The general discussion in this note refers to the article by Heady and Pesek, "A Fertilizer Production Surface," *This Journal*, Vol. XXXVI, No. 3, August 1954, pp. 466-482.

[1] Iowa Agricultural Experiment Station Bul. 424.

to indicate all similar-cost ratios for all yield levels.) In a family of isoclines one denoting a substitution ratio of 1.0 may be "bent"; one for a .5 substitution ratio may be linear. Hence, with a nutrient price ratio of 1.0 least-cost fertilizer mixes will not include a 1 : 1; or even a fixed ratio; with a .5 price ratio, the fertizer mix should follow a fixed ratio line, although no particular ratio can be specified without knowledge of the function. One of a family of isoclines may be straight (although it need not be one along a 1:1 ratio); none may be straight. Figure 1B emphasizes our point. The isoclines shown for alfalfa were derived from a similar experiment. Notice that these are "bent sharply." Their curvature

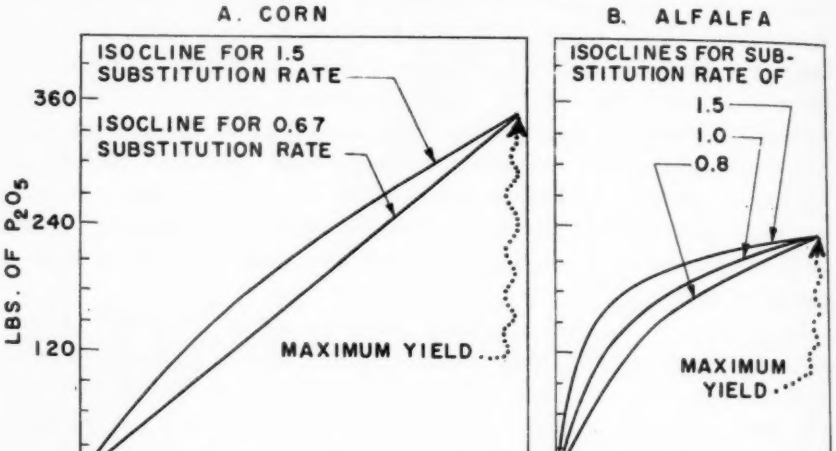

FIG. 1. ISOCLINE MAPS: A. P_2O_5 AND NITROGEN ON CORN. B. P_2O_5 AND K_2O ON ALFALFA. ISOCLINES SHOW PATH OF EQUAL SUBSTITUTION RATES (I.E. LEAST-COST EXPANSION LINES FOR GIVEN PRICE RATIOS) OVER CONTOUR MAPS ($\Delta P/\Delta N$ IN 1A AND $\Delta P/\Delta K$ IN 1B).

suggests that if the least-cost nutrient combination is to be attained the proportions of the nutrients may need to change considerably under particular situations.

Two isoclines can be called *ridge lines*. They denote zero substitution or replacement rates. If (1) the ridge lines are not far apart, (2) the isoclines within their boundary are fairly straight and (3) the yield isoquants for a particular yield have only a slight curvature with a slope not far different from the nutrient price ratio, several nutrient ratios, within the boundaries of the ridge lines, will give costs that are only slightly different (although only one isocline will denote exactly the least-cost nutrient combination). If (1) the ridge lines are "sprung far apart,"

(2) isoclines "bend sharply" and (3) yield isoquants "curve sharply" away from price ratios, savings from changing nutrient ratios along an isocline will be considerable. Since ours is the first experiment to estimate these quantities, we do not know whether the first or last situation will generally hold true. We suspect that the range between the two situations will vary among crops, soils and years. In addition to space limitations, we did not mention this in our article because we thought most economists were acquainted with these concepts and their application.

Our method and principle are useful for any yield level. We illustrated with rates that would maximize profits above fertilizer cost in the sense of (1) the least-cost ratio for the given yield and (2) the optimum fertilization level. However, most farmers are limited on capital and seldom go to fertilization rates of MC = MR. They still need, however, knowledge of the least-cost ratio for about the yield level they can attain, considering the opportunity returns their capital will yield in hog feed, cattle or tractor fuel. In other words, the fertilizer recommendation needs to vary with the capital level of the farmer, as well as the soil. (We did not explain this detail because we felt it to be of common knowledge, and space prevented us from unraveling the following points.) Our system provides the basic data for the whole range of farmers and not just those who can nearly equate MC and MR for fertilizer. The Hutton and Thorne scheme would not. Here is where our general method is more practical than theirs; it is here that their scheme may result in a relative "waste of agronomic resources" as compared with ours. Ours is the more economical experimental system because it can be used for the farmer in capital positions to attain 60, 80, 100 or 120 bushels. Even if the design we use costs 100 percent more than theirs, it would be much more productive and allow recommendations to a much wider range of farmers and capital situations. Our system allows us to make recommendations of the least-cost ratio for a 60 bushel yield; theirs does not. Their system allows estimate of only two simple input-output curves along the dotted lines shown in figure 2. It does not allow estimates of isoquants such as those we present. If one used their "line perpendicular to the nitrogen axis," he would predict an 80 bushel yield with 160 pounds of N and 33.2 pounds of P_2O_5.[2] At prices of 14 and 9 cents per pound respectively, the 80 bushel yield would require a fertilizer outlay of $25.39. Using the same prices and the isoquants from our data (which could not be predicted from their data), we find that the same yield can be attained for about $12.60 if one uses the least-cost ratio for the particular prices. The

[2] These quantities are derived from the following equation, with N fixed at 160 lbs (i.e., one of the two single-variable lines which Hutton and Thorne would use).
$Y = 14.35 + 13.885\sqrt{P} - .4335P$

cost is $18.23 for an 80 bushel yield if one used their lines perpendicular to the P_2O_5 axis.[3] Other yield levels give similar differences between their recommended procedure and the one we use. Since most farmers in western Iowa are short on capital and with the more progressive ones currently thinking in terms of 60 or 80 bushel, we feel that our system is more practical than theirs. It allows prediction of every point in Figure 2 (i.e., the whole surface or as many as 400 lines, and not just the dotted

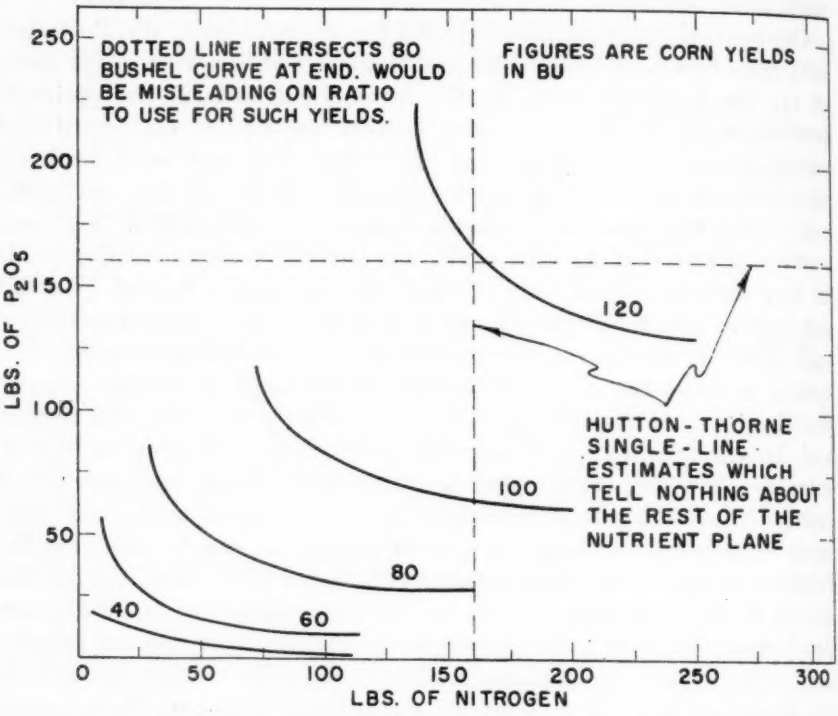

FIG. 2. COMPARISON OF SURFACE ESTIMATES WITH SINGLE-LINE ESTIMATES.

lines). We would not need to run the experiment again for recommendations to a "70 bushel farmer"; Hutton and Thorne would need to do so with their "single lines"; they would eventually require more plots than ourselves, but they would have difficulty in estimating the surface from them if they used different locations in different years. It is by chance that the two dotted lines in Figure 2 cross near the optimum yield, under unlimited capital of around 120 bushels. If corn prices fell, pushing opti-

[3] The quantity of 27.4 pounds of N necessary for an 80 bushel yield with P_2O_5 fixed at 160 pounds (i.e., the other single-variable line Hutton and Thorne would estimate) is derived from the function: $Y = 23.67 + 12.82\sqrt{N} - .3927N$.

mum yield to 80 bushels, or if the production function had proved to have more or less elasticity, different yields would have been optimum and this "chance coincident" would not have occurred. The possible error from their system increases with distance from the point of intersection of the dotted lines. Since we predict every point in the nutrient plane, our estimates do not have the same weakness.

Finally, we need to point out this: This loss or gain from "rules of thumb" or "economic principle" depends on the yield level within the boundaries of the ridge line. If the yield to be attained is relatively near the convergence point, as is the yield for the prices used under an "unlimited capital situation," the isoquant is short because the ridge lines are close together: a relatively few combinations will produce a given yield and may have only somewhat different costs. However, as one moves to lower yields, the ridge lines spring farther apart and the isoquants within their boundaries have much greater curvature. Therefore, the "correct economic principle for a given yield" can give much greater profit than Hutton and Thorne's "rule of thumb," which takes one near the ends of isoquants falling low in the isocline map.

Our study was designed to estimate a production surface. Accordingly, we could not use the 34 plot technique suggested by Hutton and Thorne.[4] The experimental set-up designed for us was not necessarily the one we would have suggested. Neither would we have used Hutton and Thorne's approach. With "hind sight" growing out of our experience, we might well have used a single plot for each treatment, 57 plots in all. Empirically, we did obtain much more scientific information per plot than their system would allow; 57 plots would have been even more efficient for our purpose.[5] We believe that our system stands to allow more information at a lower cost than isolated experiments wherein one nutrient is held constant at one level, and the other is varied in one year, with several similar "single line" experiments run in late years. Having completed our experiment, we can now look backwards and make such *ex poste* statements as: "These two lines alone, by chance, would have allowed economically permissible recommendations for one yield level." But faced with the *ex ante* task of guessing the two lines to predict, we might have been in error. (The research worker could only guess; he would not

[4] We already knew that two such lines could be predicted and had, as our article indicated, predicted them as an aid in selecting our production surface equation.

[5] We estimate that 57 plots would have added about 20 percent to the total cost, as compared with 34 plots. Considering the much greater amount of information obtained from this general system (and the fact that Hutton and Thorne would not know whether they were *"far from or close to"* the economic optima after their first year), we look upon this general method as scientifically efficient as compared with theirs. Their statement about "wasting resources" sounds a bit rash and out of order, considering what we feel is an original contribution to scientific knowledge.

run the experiment if he knew.) If we obtained the "wrong two" lines, we would have to predict two more lines. In fact, we could never tell with certainty that any two lines are correct, even after we had predicted them. Perhaps it never occurred to Hutton and Thorne that the "two line" conclusion was possible only because we had predicted the complete surface and provided the isoquant magnitudes for comparison.

Hutton and Thorne are incorrect in stating that our data did not show important interaction. The statistics, including those presented in the article, show the interaction term to be highly significant (i.e., above the one percent level of probability).[6] We think that the approach can be useful and should be extended to other crops and locations. It is the first step in resolving questions posed as early as Von Leiberg but yet incompletely answered. Such data provide the fundamental and correct framework for fertilizer recommendations. Where the approach should be used, of course, depends on the soil and its particular nutrient deficiencies for a crop. Obviously, one would not try to estimate a two variable function where only one nutrient is deficient. To suggest that one must have interaction to make such an experiment worthwhile is a trite statement. The analysis of variance table below shows that we obtain highly significant interaction (i.e., at above the one percent level of probability).

ANALYSIS OF VARIANCE OF CORN EXPERIMENT

Source Variation	df	Sum Squares	Mean square	F value
Total	113	242,707		
Treatments	56	233,811	4,175	26.76*
Nitrogen	8	93,366	11,671	74.81*
Phosphate	8	113,934	14,242	91.29*
Interaction (N_xP)	40	26,511	663	4.25*
Among plots treated alike	57	8,896	156	

* Highly significant (e.g., at .1 percent level of probability).

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[6] Simple examination of the curves on page 474 and 478 indicate this also.

AGRICULTURAL OUTLOOK WORK, NATIONAL AND INTERNATIONAL

WITH the growing emphasis placed by governments on planning and programming their agricultural production, interest has increased in many countries in attempts to forecast the short term development of production, prices and marketing of agricultural products. Since 1949 such agricultural demand outlook statements have also been pre-

pared for the world as a whole and for broad geographic regions, as well as for a number of specific commodities, by the Food and Agriculture Organization of the United Nations (FAO). These are published in FAO's annual report on *The State of Food and Agriculture*. The problems involved in appraising future trends on the international level and the accuracy obtained in these forecasts are discussed in an article recently published by Mordecai Ezekiel.[1]

After a brief description of the bases for appraising the future prospects of agriculture and the limitations inherent in all economic forecasting, Ezekiel gives a short history of the agricultural outlook work done in the United States and Canada, stressing the remarkable progress achieved in the dependability of this type of work in both countries. Official economic forecasts in Europe, also summarized in the article, are largely restricted to the preparation of annual national budget forecasts which also have shown satisfactory accuracy at least as far as direction of change is concerned.

The preparation of the general and commodity situation and outlook statements by FAO involves, of course, much broader problems than similar work done nationally. Such problems concern not only the general economic conditions and prospects of the most important countries in each region of the world and their mutual repercussions, but also the effects on national and international markets, prices, trade and consumption of agricultural products. These analyses require a considerable volume of factual information that is collected from such national review and outlook statements as mentioned above, from situation and trend analyses prepared by the U.N. and some of its specialized agencies and regional economic commissions, and from economic indicators collected by FAO for all major economic regions of the world. A preliminary draft of the outlook statement is submitted by FAO to a number of leading economists all over the world and is revised in the light of their criticism and suggestions.

The rather difficult attempt of FAO to extend agricultural outlook statements to such a heterogeneous area as the world as a whole has so far been greatly facilitated by the fact that the general economic level, and hence the demand for agricultural products in the world, has been mainly determined by the level of and the changes in economic activity in the economically more advanced parts of the world, particularly North America and Western Europe, for which large amounts of economic data and many national forecasts of future business and industrial activity

[1] Agricultural Situation and Outlook Work, National and International, *FAO, Monthly Bulletin of Agricultural Economics and Statistics*, Vol. III, No. 6, pp. 18-20, Rome, June 1954.

are available. As suppliers of raw materials and as markets for finished products, the economies of the more underdeveloped areas of the world react to a certain extent to developments in the industrialized regions and thus permit some broad forecasting of demand even in the absence of sufficient quantitative economic data from the underdeveloped regions.

Another aid for appraising demand trends in the less industrialized countries is the demand and supply position forecasts for individual commodities or commodity groups that form an integral part of FAO's outlook statements. While such commodity forecasts are partly based on the general economic analysis, they are mainly the results of FAO's regular and continuous commodity economic intelligence service which gets its basic information directly from member countries, from intergovernmental and private commodity bodies, and from the periodic meetings of commodity specialists at FAO's Headquarters.

In the final paragraphs of his article, Ezekiel gives a graphic and tabular "batting average" for FAO's general and commodity demand forecasts. This record compares not unfavorably with that of the USDA, in spite of the relatively short experience with this novel type of international outlook statement and the far greater difficulties in its preparation. An appendix illustrates the method of how FAO forecasts were scored, using the commodity group Fats and Oils as an example. Of 28 forecasts made for this admittedly difficult group, 20 proved in the right direction, yielding a score of 71 percent correct, or only slightly below the 76 percent general average scored for all 219 "usuable" outlook statements of FAO.

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BOOK REVIEWS

The Economics of Location, August Lösch (translated by William H. Woglom), New Haven: Yale University Press, 1954. Pp. xxviii, 520. $7.50.

The Economics of Location is a landmark in the literature of location analysis. Any scholar in the field of land economics, community planning, industrial or agricultural location, regional analysis, or even international trade should acquaint himself with this book.

Even before it was available in English, this work exerted a wide influence on economists in this country. Hoover and Isard have drawn heavily from it. This writer on several occasions has had mental blocks removed by the ingenuity and imagination displayed by Lösch. When a book written in German commands such attention in this country as to be generally known and widely quoted it demands translation. Mr. Woglom has performed a distinct service to the profession by making this work more widely available.

The contents of such a monumental work cannot be adequately reported in a brief review. However, several contributions stand out.

Lösch was the first to present a general equilibrium system of the Walrasian type that explicitly encompassed the details of a space economy.

One of the most imaginative and intriguing parts of the book is the description of economic regions. By an ingenious train of logic and convincing diagrams the author demonstrates that economic activity will become agglomerated into production and consumption centers even in the absence of the usually identified causes of this phenomenon, such as transport, economies of scale, disproportionate costs of short hauls, and "umbilical" factors like dependent industries. The result is a region of higher and lower orders of market centers arising out of a natural arrangement of market areas of different sizes. The end result is suggestive for techniques of market analysis and provides a flexible and functional concept of the region that is vastly more useful than the old "homogeneity" or "self-sufficiency" concepts.

This book also includes industrial location theory and agricultural location theory. Lösch's analysis of the well-known Thünen rings is highly original. An extensive discussion of trade and spatial differentials in price seems valuable. A 150 page section devoted to empirical examples that illustrate and amplify his theoretical discussions is worthy of particular note. These data make the text particularly useful for American economists because they virtually all pertain to American experience.

The Economics of Location is not without its drawbacks. The best parts are incomplete or inaccurate in some detail. Lösch's general equilibrium scheme, for example, is overdetermined.

In examining the Thünen ring formations Lösch performed a particular service by making explicit (1) the conditions for ring formation, (2) the reasons for ring formation, and (3) the boundary line between two forms of production. Each of these steps, however, is deficient in some measure. In defining the conditions for ring formation Lösch divides out the variable representing the transport rate. There are three consequences to this maneuver. First, it amounts to an implicit assumption that the transport rate is the same for all commodities. This obviously weakens his conclusions. Second, Lösch never succeeds in making an algebraic statement that is an explicit distance function. Third, he succeeds only in stating the necessary conditions for ring formation and not the sufficient conditions.

This is not a pastime book. It is closely reasoned and the reader may be provoked at times because the austerely concise presentation obscures some path of logic.

Such defects cannot conceal the originality and sheer weight of effort revealed. Moreover, the defects are understandable when one knows the adverse circumstances under which this work was conducted. *The Economics of Location* was written during the war. Like Albert Einstein, another distinguished Swabian, Lösch refused to make compromises with the Nazi regime. In consequence he sustained many privations and indignities. The fact that such a work as this could be brought to completion under such circumstances is a tribute to rare courage and inspires confidence that the evolution of human knowledge knows no obstacle. August Lösch died prematurely on May 30, 1945.

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Evolution of Futures Trading, Harold S. Irwin, Madison, Wisconsin: Mimir Publishers, Inc., 1954. Pp. xii, 95. $3.00.

This little book seems to me open to either of two contrasting appraisals. It may be thought an unconvincing effort to build a case for a novel view of the origins of futures trading; or it may be judged a distinguished contribution to the theory of markets, the more remarkable because the author was able to see the truth among facts that could so easily be thought to support a traditional, false interpretation of the origins of futures trading.

A review based on my initial reading of Irwin's argument would have expressed the former of these judgments. But it was in 1946 that I first

read what was to become the central part of this book. Some years later, Irwin's thesis returned to mind as I reflected on other facts regarding futures trading, and I saw that a logical extension of his theory could explain much that remained otherwise obscure.[1] It is now clear to me, beyond any doubt, that this book is a major contribution to the understanding of both the origins and the modern functioning of futures markets.

The central contention of the book, I should say, is that futures trading arose independently in each commodity out of specific needs of the commodity trade, and that nowhere did the author find evidence of the emergence of futures trading primarily as a medium for speculation. To state the conclusions so shortly is oversimplification, but in the light of previous doctrine this must be counted the outstanding point in the conclusions, and it is also a point that must be accepted before other conclusions in the work become at all readily accessible to a reader.

In his Preface, Irwin admirably summarizes the purpose and contents of the book:

"The principal reason for undertaking this study early in 1942 was the opportunity to obtain the help of the older wholesale butter and egg dealers at Chicago in preparing an account of the development of butter and egg futures. A number of those dealers had been in that business for some time before organized trading in butter and egg futures began in 1919. Studies of grain and cotton futures had shown that the published records lacked much of the information essential to an adequate analysis of the reasons back of the development of each; information which presumably could have been obtained earlier from the grain and cotton merchants and brokers. Since such information concerning grain and cotton futures had been lost, there was all the more need to obtain it for butter and egg futures.

"Recognition of the pattern of evolution in butter and egg futures led to a detailed analysis of the origin and development of time contracts in grain at Chicago, prior to organized trading in grain futures. This study was followed by a less detailed study of the subsequent development of grain futures and of the development of cotton futures. Because much of the material concerning grain and cotton futures was obtained from secondary sources, this material is placed in an appendix."

Less is said later about butter marketing than one might expect from this summary. The reason given is that "The story of butter marketing is complicated. . . . The story of early developments in egg marketing is

[1] Some of the results of this reflection have appeared in my "Futures Trading and Hedging," *The American Economic Review* (June 1953), pp. 315, 318-20, reprinted in *Contemporary Readings in Agricultural Economics* (Harold G. Halcrow, ed.), New York: Prentice-Hall, 1954, pp. 157-71, and "Whose Markets?—Evidence on Some Aspects of Futures Trading," *The Journal of Marketing* (July 1954), pp. 3, 4.

simpler and, in general, it provides an adequate basis for the understanding of the development of futures markets in both commodities" (p. 6).

The book is not without some apparent faults in detail—reference 72 credits me with sole authorship of a publication of which Sidney Hoos was co-author, and it would seem that some reference should have been made to H. C. Emery, *Speculation on the Stock and Produce Exchanges of the United States* (1896)—but my main impression is that the body of the work represents a great amount of careful inquiry and scholarship. It would be more immediately convincing if the author had succeeded in conveying an impression of his reasons for trusting the judgments of those informed businessmen in the produce trade whose opinions, one may infer, led him to pursue the idea that futures trading in butter and eggs had in fact arisen directly out of business needs; but that does not matter if the evidence proves convincing otherwise. The descriptions of business advantages gained from use of time (forward) contracts in general, and futures contracts in particular, seem not the easy generalizations that are sometimes met in discussions of futures trading, but statements worded carefully to say only so much as the author had evidence to support.

Appendix I, which undertakes to reinterpret information on the origins of futures trading in grains at Chicago and in cotton at New York in the light of the author's findings with regard to futures trading in butter and eggs, makes no claim to having been based on as thorough study as the main part of the book. Its inference that the "transition from trading in time contracts to organized trading in grain futures" at Chicago probably occurred "between 1870 and 1875" (p. 82), contrary to Charles H. Taylor's opinion that futures trading in grains at Chicago began prior to 1850, must have been drawn without knowledge of the fact that Taylor was an active member of the Board of Trade from 1868.[2] Inasmuch as he knew futures trading as it existed in later years (Taylor was a director of the Chicago Board of Trade in the early 1900's) his opinion seems to deserve credence at least in its implication that futures trading was a well established institution at Chicago by 1868. I am inclined to agree with Irwin that Taylor was mistaken in regarding emergence of futures trading in grains as probably a direct outgrowth of "to arrive" contracts, and I think it plausible that Taylor may have put the date of the first futures trading somewhat too early, as a result of ambiguity of the word "futures" in published accounts of early transactions.

If Irwin has left the facts with regard to the earliest futures trading in some doubt, he has done a service in suggesting that previous ideas on the subject need to be re-examined. One should not expect to find that

[2] Charles H. Taylor, *History of the Board of Trade of the City of Chicago* (Chicago, 1917), III, 317.

the earliest futures trading emerged through any clearly marked transition from use of other sorts of time contracts to well organized futures trading, such as occurred later in the case of butter and eggs. What further historical research might accomplish, I think, is to reveal approximately when a portion of the contemporary dealings for forward delivery became specialized, in the direction of modern futures trading, to such an extent that people began to distinguish between that class of forward transactions and others (though the others continued often to be called "future" transactions); and to record the successive steps in development of that specialized form of trading.

The publishers deserve commendation for their assistance in bringing this useful work into print, and for the attractive dress in which it is presented.

HOLBROOK WORKING

Food Research Institute
Stanford University

American Farm Life, Lowry Nelson, Cambridge: Harvard University Press, 1954. Pp. vii, 192. $3.75.

American Farm Life, latest book in the Library of Congress Series in American Civilization, is written for the so-called intelligent layman. As stated in the jacket blurb, it is an attempt at presenting "the situation of rural people in a clear-cut fashion for their city neighbors." It is against the backdrop of this purpose that the book must be appraised.

The author does not wish to limit himself to a statistical or word description of American agriculture, but seeks also to give the city neighbor an understanding of what makes rural people what they are—what makes them think and act as they do.

To do this, he selects strategic aspects of rural life for rather detailed description. Because he recognizes that farm life is too dynamic to be captured adequately in any still picture, he discusses most issues within their historical setting, hoping to give the reader sufficient understanding of the fact that rapid and profound change itself is one of American agriculture's truly salient characteristics.

Strangely enough, one of the most important characteristics deriving from the American farmer's rural heritage is born of paradox; his essential bivalence on the issue of local self-determination versus dependence on central government. Although geographic isolation of frontier living fostered self dependence and the trait of individualism, in many important economic affairs, such as the survey and distribution of land, farmers were tied to the federal government either directly or in early days through the territorial governments. "From that government they received their official title to land, and to that government they appealed

for redress against the railroads and the bank when the products of their land could find no outlet in the market place at a price they considered just."

Following the discussion of the Rural Heritage the author sweeps through three chapters entitled A General Survey, The Technological Frontier (which appears to mean, to him, largely mechanization), and The Farm Labor Force. The agricultural economist will find little in these chapters not abundant in professional literature. (This is of course no criticism of the book.) His chapter on The Farmer's Community is too brief to go very deeply; but it does hint at the important issue in the breakdown, or at least drastic modification, of the rural community under the impact of modern facilities for transportation and communication.

The chapter on The Farm Family is quite disappointing to this reviewer, particularly in view of the fact that the author is a sociologist. He discusses various aspects of farm families—their incomes, sizes, expenditures, etc. But the meaningful issues of what the intensely familiar character of social and economic organization of American agriculture means to the way farmers think and act remain beneath the surface.

The three chapters on The Farmer's Schools, The Rural Church and The Farmer and His Local Government are very informative. In all three, the central problem is the same—too many and too small. Through consolidation, schools are already well on the way out of the problem. Inertia and politics inhibit similar improvement in local government, as does sectarianism in the rural church.

The chapter on Farmers' Cooperatives and, particularly, the chapter on Farm Organizations contribute very little. The chapter on Federal Government briefly and effectively comments on leading governmental services to farmers. The last chapter entitled The New Farmer attempts to establish a bridge from the author's picture of American farm life at mid century into the dynamic and inscrutable future.

The book will be useful to others in addition to the "city neighbor." Agricultural economists may well prescribe it for beginning undergraduate students, for graduate students lacking farm background, for foreign students, and even for himself when he wishes a pleasant and easy two hour overlook at American farm life today.

ERVEN J. LONG

The University of Tennessee

Food and Agriculture in Britain, 1939-1945; Aspects of Wartime Control, R. J. Hammond, Stanford: The Food Research Institute, Stanford University Press, 1954. Pp. xii, 246. $5.00.

This book is the seventh in the series from the Food Research Institute on "Food, Agriculture, and World War II."

For more than ten years, Mr. Hammond, a senior member of the Historical Branch of the Cabinet Office in London, has been studying the massive archives of the wartime Ministry of Food, and carefully analysing, judging and summarizing this Ministry's problems and purposes, successes and failures. The first volume of his official history, *Food, Vol. 1; the Growth of Policy,* appeared in 1951, and more detailed commodity studies are promised. This Stanford book is largely a by-product of Mr. Hammond's official work; but he has contrived to make it a distinct contribution, distilling into it experiences and results of interest and value particularly to overseas readers. He has also made it enjoyably replete with many colorful comments. Thus, to take but one example, in discussing the addition of vitamin and other supplements to bread flour he writes: " . . . it must be remarked that some of the arguments used by the opponents of fortification partook, and partake, more of the character of religious belief than of scientific evidence. (It is of some sociological interest that some of the most ardent of them were Peers.)"

The main task of the Ministry was to see that the 48 million people of the United Kingdom were well and satisfyingly fed, despite a reduction in imports of food and feeding stuffs from 22 million tons a year during the late 1930's to 10.6 million tons in 1942, and despite inflationary conditions, bombing, and shortages of manpower and materials. This main task entailed problems in overseas procurement, import programming, home production planning and marketing control, supervision of processing, supply allocation to wholesalers and retailers, rationing and other consumption controls, prices and subsidies, and public relations. The Ministry, in facing these problems, had many advantages: considerable commercial, civil service, and university manpower, the central and local organizations of the Agricultural Departments, the wartime incentives of farmers, the latent production potential of home agriculture, Lend-Lease, and the comparative absence of subsistence farming. Even so the degree of success achieved was impressive.

The essentials of success were largely determined just before September 1939 or during the first eighteen months of war. "In order to control food-stuffs, the Ministry must itself trade in them, i.e. must become their owner at one or more stages of distribution," through using firms as agents. ". . . rationing to be effective . . . must not rest only on the control of supplies but on the tying of each customer to a single retailer." Even more important, it was early decided that grassland must be ploughed up, that feeding-stuffs would have a low order of priority in the import program, that dairy cows would have highest priority in the use of feeding-stuffs and pigs and poultry lowest priority, and that among tillage crops, wheat, potatoes, sugar beets and vegetables would be most increased. The necessary changes in the volume and composition of the

output of home agriculture were to be brought about by close local guidance and supervision, by fixing product prices and by control and even some subsidization of fertilizers, machinery, and other factors. And, not least important, was the early decision to bring carefully chosen Commodity Directors into the Ministry of Food, and experienced local farm leaders into the Agricultural Departments as members of County and District Agricultural Executive Committees.

Whatever follies, imperfect knowledge, inadequate administrative experience, unwillingness to think hard and far enough, overearnest desires to 'save ships', and personal ambitions affected the carrying out of these policies—many illuminating ones are discussed—and whatever part of the Ministry's success can be ascribed to the breathing spaces it had during the first two years of war, there can be little doubt that these policies were sound and basic. With the benefit of hind-sight it may also be claimed that they were obvious and learned largely from experiences in 1917 and 1918. Perhaps for this reason Mr. Hammond does not discuss them fully but pays more attention to less fundamental schemes that failed and their lessons for control of prices and distribution and for the achievement of adequate nutrition. One of his main conclusions is, therefore, that, "For all Lord Wolton's panache and business shrewdness, for all the brilliant staff his Ministry recruited, the qualities most evident in its work are not brilliance in formulating policies, nor virtuosity in their execution, but doggedness and patience in retrieving situations and seeking new solutions." But this is obviously not the whole reason for success. We may nonetheless accept as a generalization for use in relation to some peace-time policies that "The attempt to replace market forces . . . by conscious direction . . . meant a strain in the controllers so great that several leading members of the Ministry . . . broke down under it."

JOHN R. RAEBURN

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University of London

The Limits of Foreign Policy, Charles Burton Marshall, New York: Henry Holt and Company, 1954. Pp. 128. $3.00.

Once in a while someone writes a book on a great national or world issue that is so clearly distinguished from the ordinary run of such books by its intelligence, imagination, and facility of expression that it stands out as an authoritative statement of classic quality. Charles Burton Marshall's wise and witty essay on America's approach to the outside world deserves to be acknowledged as a classic in the field of foreign policy.

The Limits of Foreign Policy has been widely acclaimed by politicians, academicians, and public officials. It should find an enthusiastic popular audience among that important group of citizens who simply want to be

informed beyond the headlines and news flashes about the most serious public issues affecting their daily lives. It is with the peculiar educational value of Marshall's book in mind that my colleague Charles M. Hardin has brought it to the attention of a number of state representatives engaged in public policy work in the Agricultural Extension Service.

In a day when events in the most remote parts of the world excite intense controversy over American action and our highest representatives are thinking and talking in terms of a generation of international crisis there is no need to explain the importance of writing about American foreign policy. But, unfortunately, heretofore the subject has been too largely appropriated by scholarly monographs and specialized texts, on the one hand, or undistinguished polemics and journalistic rehashes of current events on the other hand. This book is of quite a different order.

As a former member of the State Department's Policy Planning Staff and a consultant to the House Committee on Foreign Affairs, Marshall writes with the knowledge of a practicing expert, but he places diplomatic and military problems in the broader context of the public's basic attitudes toward foreign policy. He has a point of view to present; but it transcends any attempt to solve a particular problem, and it grinds no axes. Marshall is interested in *how* to think, not *what* to think, about American foreign policy.

His central thesis is that this country can gain security only by facing up to its limited capacity to arrange the world according to its ideal desires. Foreign policy is not a set of good wishes or high aspirations but a series of hard choices among practical alternatives, all of which are likely to be undesirable and mutually incompatible and none of which guarantees a total solution to a single vexing problem. Excessive expectations lead to frustration and disillusionment. Realistic, hence modest, expectations are essential to a sound foreign policy. Therefore, "The problem is how to acquaint Americans in general, whether in government or out of it, with the inherent limits respecting foreign policy so that issues may turn on questions how best for the nation to fill the limits rather than on vain propositions of perfection and destructive self-reproach over failure to achieve it."

Pointedly but without rancor Marshall analyzes certain deficiencies in America's past approach to foreign relations: the compulsion to escape from responsibility, the illusion of omnipotence, the addiction to panaceas, the utopian faith in the efficacy of documents and pronouncements, the belief that international conflicts can be settled by the judicial and political devices of domestic society, and the whole host of fads, clichés, oversimple diagnoses, and overblown cures that have been put forth by Americans with such misguided confidence over the years. Underlying all these deficiencies is "the folly of projecting political plans with insuf-

ficient account of the irreducible realities of power." The folly is understandable, Marshall finds, in view of the nature of American society and American political experience—especially her fortunate insulation from the adversities of European power politics. But today our security is too seriously threatened for us to afford the luxury of immaturity. The novel demands of leading a coalition by consent, not coercion, enjoin us to exercise a degree of realism, compassion, urbanity, humility, and patience such as no other nation, least of all our own, has ever had to display.

The implications of this general advice are numerous, as Marshall develops them. No summary can do justice to his profound but lucid elaboration of the essentially simple thesis at the core of his book. The full wisdom of this book lies in the various observations and insights with which he skillfully weaves the central thesis together and fits it to the contemporary problem of Soviet Communism. And, throughout, the line of argument bears a distinct and original touch that cannot be adequately described by another man's words. For Marshall entertains as he instructs, illustrating his points with a wealth of material, ranging from an anonymous anecdote about a Texas jack rabbit to the poetry of Walt Whitman and the Gospel according to St. Matthew.

True to his own advice, Marshall refrains from offering detailed prescriptions for American policy in all parts of the world. But this is the strength of his book—not a weakness. For most of those who read his words will never be responsible for making specific decisions on the various problems that confront our government today; but all of them—by their general approach toward world politics and their understanding of what foreign policy fundamentally involves—will, in some measure, determine the way in which those who are responsible will make these decisions and the countless decisions on unknown problems ahead. To the end that their influence may be constructive, Mr. Marshall's readers can do no better than to emulate the intellectual penetration and emotional maturity that the author demonstrates on every page. May they also bear their limitations with his refreshing good humor.

ROBERT E. OSGOOD

Center for the Study of American Foreign Policy
University of Chicago

A Foreign Economic Policy For The United States, C. B. Randall, Chicago: The University of Chicago Press, November, 1954. Pp. vii, 83. $1.95.

This little treatise might well be rechristened *A Statesman's Handbook*. It is a result of three Walgreen Foundation Lectures, given at The University of Chicago, November 1, 2 and 3, 1954.

Mr. Randall needs no introduction to those who followed the proceedings of the 1953 Commission on Foreign Economic Policy (hereafter the *Commission*), of which he was Chairman. This reviewer feels that those who, along with himself, were disappointed in the Report of the Commission (House Document no. 290, 83rd Congress, 2nd Session; hereafter the *Report*) will be more pleased with the impassioned unselfishness and timely logic that permeates the book. But it is difficult to treat the book without also remembering that its foundation rests on much of what is said in the *Report*.

A take-off on the old aphorism, or song title, "It ain't whatcha do, it's the way you do it" may be applied here. It is not what Mr. Randall says, it's the way he says it. No new principles or ideas are set forth, but the old ones, more musty with intellectual polyphagia than from time, are infused with language or philosophic medium that is no less than delightful to a would-be free trader.

After the first lecture on Our Dilemma and Its Urgency, which reads as much like an economic sermon as foreign policy recommendations, Mr. Randall ploughs into the problems of liberalizing trade. In the two remaining lectures, though no such outline was followed by the author, the reviewer felt that he was being presented with several specific considerations for resolving the dilemma set forth in Chapter One.

The first consideration deals with increasing the foreign investment of the United States. Mr. Randall proposes that capital flow abroad be stimulated through tax incentives, by revision of the laws that govern investment trusts relative to funneling savings abroad, by creating a favorable environment for capital in foreign countries so they will reduce arbitrary and discriminating practices against United States capital, and by creating a better investment climate through legal adjustments and reforms as well as by building up segments of competent professions such as accounting, etc. As an adjunct to the solutions of the foreign investment problem, encouraging the flow of the American funds abroad through tourism receives a special treatment.

Mr. Randall considers next the changes needed in our tariff policy. Quite rightly, he eliminates all the false arguments for the protection that some industries now enjoy. Paradoxically, this section is the most disappointing one of his proposed policy. He recommends a *gradual, selective* revision of tariff barriers along the line of that proposed to the President by the Commission. The recommendation that the President be allowed to reduce existing rates by not more than five per cent per year for three years is so scanty that it will bring no real relief to hard pressed countries like Japan, some of the rates against which are still at the Smoot-Hawley level. Moreover, this small reduction offers little in the way of bargaining power and will not greatly affect tariff negotiations.

Also disappointing in this section, as well as in the *Report*, is the way in which Mr. Randall passed off Mr. D. J. McDonald's proposal for compensating victims of tariff cuts. This proposal is one of the boldest and most imaginative ideas since the Trade Agreements Program was initiated and, although in need of supplementation, revision and refinement, should not be left as an afterthought, to be covered up with excuses such as Mr. J. H. Whitney's statement that "The Commission's recommendations contemplate no dislocation of American industry and labor which might result in extensive hardship." (See *Report*, p. 59).

As a third consideration, our present customs regulations, 'Buy American' policy, shipping subsidies and subsidies on agricultural exports are deplored, as would be expected, but there is an unusual freshness and candor about Mr. Randall's statements in this regard. He points out, and correctly, that the impact of our agricultural program upon our foreign policy is so dominant that we shall never bring world trade into balance until an answer is found. But it is difficult to concur wholeheartedly that there are fundamental "differences between our basic philosophy and that of other nations" with respect to price agreements, allocation of markets, production quotas, etc. It depends on how one defines *basic* philosophy. The more basic difference (as of 1955) would seem to lie in the area of relative positions of production and exchange. A particular topic in this regard which seems to be forgotten by many who touch on this subject is that the United States is in the unfortunate position of being a highly efficient, high volume producer of both agricultural and industrial goods. In fact, this position has no historical precedent.

The reviewer agrees fully with several other considerations set forth by the author; namely, that East-West trade in non-strategic commodities is not only desirable but unavoidable if we are to live in peace, that the United States must provide the leadership in the establishment of convertible currencies, and that the principal roadblocks to attaining desirable goals in foreign economic policy is the lack of understanding of the problems by the American public and the unwillingness of private enterprise to place the general interest above special, selfish, and immediate goals. Indeed, he concludes that this last tendency is a threat to our very existence and way of life.

Throughout this short discourse, one cannot forget *who* is saying these words. We are fortunate that a man of Mr. Randall's stature thinks as he does and is in a strategic position of policy making. The principal danger would seem to lie in the possibility that his admonitions to patience, humility, understanding and sacrifice will go unheeded, first at home, then abroad.

JIMMYE S. HILLMAN

University of Arizona

Papers and Proceedings of the Conference on Agricultural Taxation and Economic Development, Held Under the Auspices of the International Program in Taxation, Law School of Harvard University, January 28-February 3, 1954. $4.50.

As part of its International Program in Taxation, the Law School of the Harvard University early in 1954 brought together leading United States foreign experts for a Conference on Agricultural Taxation and Economic Development. The published proceedings now make available a brief summary of the plenary discussions, the reports of the four work groups, and the working papers of the Conference.

That this has been the first undertaking of this kind demonstrates how long systematic economic research has neglected the importance of fiscal problems in economic development. It is highly gratifying, therefore, that the Harvard Law School took the initiative to promote study of the multitude of the problems in this field. Reports of the work present excellent outlines of the problems and research tasks. Our attention is drawn to many specific research problems: relationship of tax liability and tax relief incentives to inflation, implications of taxation on agricultural exports, single-crop tax problems, effects of agricultural taxation on production, investment and consumption, development of a tax service corps of career officials, citizen participation and other administrative aspects of taxation in underdeveloped countries, integration of the taxes (and one should add, tax substitutes, such as multiple exchange rates) in such countries, tax problems associated with forms of land tenure, deficiencies in tax assessment (which sometimes penalize efficient operators), development of local revenue collection in conjunction with the development of local government, distribution of tax burden and tax incidence upon farm and non-farm groups, tax capacity and its growth with economic development.

The plenary discussions and the working papers set up the tax problems against basic questions of agricultural and developmental policy. Important contributions have been made in the papers of Walter W. Heller, Gustav F. Papanek, Philip M. Ramp, and authors in the Fiscal Division of the Department of Economic Affairs of the United Nations. A number of authors have made studies of tax problems in selected underdeveloped countries.

Among the many questions discussed in these papers are the following: relationship of taxation to capital formation, relation between deficit financing and economic stability (here the reviewer feels that Professor Papanek's recognition of the habit forming quality of deficit financing, p. 218, should have caused him to be less optimistic about the possibilities of minimizing inflationary effects of such financing), modernization of primitive tax systems and their adjustment to the progressive shift from self-sufficiency to production for the market without which development

cannot be sustained, and institutional limits on the effective levying of certain more desirable types of taxes.

Professor Heller's analysis of the problems of using agricultural taxation for incentive purposes (pp. 222 ff.) deserves special mention. He points to the contrast between the ingenuity of many underdeveloped countries in devising incentive tax measures and the fact that their tax devices often turn out "to be statutory declarations of intent rather than operative parts of a tax mechanism." His chapter on prerequisites (pp. 233 ff.) summarizes well the conflicting views on the role of the profit motive in underdeveloped countries. He notes the irrationalities that play such a large role in these countries and correctly concludes that where other factors are equal the more profitable course of action "is likely to attract greater effort and risk-taking than the less profitable one" (p. 237).

Many contributors stress the tentative character of some of their findings. But even these tentative findings represent great progress. The hope seems to be justified that such findings will stimulate continuing and expanding study of the role of taxation in economic development.

Such further study makes necessary paying particular attention to the limits within which the governments of underdeveloped countries can make a contribution to economic development. Professor Papanek and others have discovered a trend in these countries toward ". . . a considerably greater governmental role than [in] many developed countries . . ." (p. 207), especially toward state enterprises, state trading, governmental financing of private enterprises and extensive direct controls of the country's economy.

Some of the contributors seem inclined to consider this to be inevitable or even necessary. On p. 93, for example, fiscal policy is called ". . . too blunt an instrument to prevent inflation . . ." and the role of a correct fiscal policy is defined as to ". . . minimize, but not completely replace the need for direct controls." Direct controls even if highly effective, however, do not prevent inflation. They only temporarily repress certain but not all of its repercussions. To make things worse, direct controls often are not very effective in underdeveloped countries. In the opinion of this reviewer, further study should aim at helping to develop the fiscal and monetary policies of underdeveloped countries to the point where serious inflation can be prevented without direct controls. Fiscal and monetary policies could become ". . . powerful tools to stimulate a maximum contribution by the private sector . . ." (p. 207). With the limits on revenue raising and administrative ability that prevails in underdeveloped countries, the rate of development in these countries will depend on the full utilization of both public and private resources.

OSCAR ZAGLITS

International Monetary Branch
Foreign Agricultural Service
U. S. Department of Agriculture

LIST OF DOCTORAL THESES COMPLETED IN AGRICULTURAL ECONOMICS, 1954

Name and Institution	*Title*
Carl Wendell Allen Iowa State College	Substitution Relationships Between Forage and Grain in Milk Production
Melvin E. Andal Michigan State College	An Appraisal of the Prairie Farm Assistance Act
Julian Hutchinson Atkinson Purdue University	Financing Agricultural Production Adjustments in Southern Piedmont
Barkat Ali Azhar University of Illinois	A Consideration of the Factors Conditioning the Economic Development of Pakistan
Aldon Gordon Ball Iowa State College	Effects of Soil Conservation and Soil Improvement Practices on Farm Profits and Management
Huey Jefferson Battle Oklahoma Agricultural and Mechanical College	Economic Effects of Some Major Changes in the Flour Milling Industry
Ronald Inglis Beazley Purdue University	Lumber Prices in Relation to the Construction of Hardwood Quality Indices
Rudolph James Becker University of Illinois	Capital Needs of Illinois Agriculture by 1975
James Wayland Bennett Louisiana State University and Agricultural and Mechanical College	An Analysis of Beef Cattle Prices
John Blackmore Harvard University	A Watershed Development Program for the TVA
Bernard Joseph Bowlen Iowa State College	Production Planning of Crops for Iowa Farms—Using Activity Analysis and Linear Programming

Name and Institution	*Title*
Robert Earl Branson Harvard University	The Structure and Efficiency of Food Marketing in Puerto Rico: a Study of Marketing Efficiency in an Under Developed Economic Area
Claude Stout Brinegar Stanford University	A Statistical Analysis of Speculative Price Behavior
Donald Lloyd Brooke University of Illinois	Some Economic Aspects of the Florida Vegetable Industry
David Jerome Burns University of Maryland	Marketing Fresh Fruits and Vegetables in Supermarket Type Stores, Washington, D.C. Area
George W. Campbell, Jr. Purdue University	A Modified Accounting System for Improved Marginal Analysis of the Farm Business
Kuan-I. Chen Pennsylvania State University	Agricultural Production in Pennsylvania, 1840 to 1950
Nam Kyu Chung University of Wisconsin	The Economic Development of the Republic of Korea
Reynold P. Dahl University of Minnesota	An Economic Analysis of the Agricultural Production Lending Activities of Minnesota Country Banks
William Lyle Dorries Agricultural and Mechanical College of Texas	An Appraisal of the Texas Veterans' Land Program
Morris Lloyd Downen Purdue University	A Study of the Milk Market of Memphis, Tennessee
John Orval Dunbar Purdue University	An Appraisal of National Forage and Livestock Incentive Programs for Adding Stability to Farm Incomes

Name and Institution	*Title*
Rollin Dunsdon University of Wisconsin	Financial and Dividend Policies of Cooperative Associations
Paul Leonard Farris Harvard University	Economic Effects of Selected Changes in Transportation Technology on Agricultural Marketing
Allie Clay Felder, Jr. Ohio State University	The Acceptance of Recommended Peanut Production and Marketing Practices in Nansemond County, Virginia, Relative to Family Organization, Family Values and Related Social and Economic Status Factors
John Ronald Frazer Iowa State College	Manufacturing Costs in Whole-Milk Creameries
Karl Gertel Iowa State College	Economic Aspects of Irrigation in the Western Cornbelt Fringe with Special Reference to the Proposed Sargent Reclamation Project in Central Nebraska
Mohamed Riad Ghonemy North Carolina State College	Resource Use and Income in Egyptian Agriculture Before and After the Land Reform with Particular Reference to Economic Development
James Clayton Gilson Iowa State College	Optimum Livestock Production Under Varying Resource and Price-Cost Situations in Northeast Iowa—An Application of Linear Programming
Warren J. Gustus University of Chicago	Commercial Banks as Lending Agencies in the South
Robert Nelson Hampton Cornell University	The Effectiveness of Various Selling Methods for Prepackaged Cut Roses in Super-Markets
Frank Detleff Hansing University of Illinois	Factors Influencing Changes in Ownership and Size of Farmland Holdings with Special Reference to Virginia
Risto Harma Cornell University	An Appraisal of the Export Subsidy Program on Butter and Cheese in Finland, 1933-39

Name and Institution	*Title*
Hubert William Harries Iowa State College	Canadian Freight Rate Control by Statute
Cecil Berdeen Haver Iowa State College	The Economics of Farm Size in Cash-Grain Farming in Iowa
William McDaniel Herr Cornell University	The Economic Structure of Agricultural Areas in New York State
Roland James Hildreth Iowa State College	Farmers' Investment Decisions in Relation to Time and Uncertainty
Jimmye S. Hillman University of California	Economic Aspects of Interstate Agricultural Trade Barriers in the Western Region
Leo Michael Hoover Harvard University	Capital and Labor Substitution on Farms in the Plains Area of Kansas
John Alfred Hopkin Iowa State College	Economics of Western Range Resource Use
Henry Joseph Hudek Iowa State College	Some Cost Relationships in Lard Processing
Elmer C. Hunter Purdue University	The Future of the Livestock Industry in the Great Plains and Range Livestock Areas
Virgil L. Hurlburt Iowa State College	Farm Rental Practices and Problems in the Midwest
Arthur William Jasper Cornell University	Merchandizing Fresh Fryers in Self-Service Meat Departments in Super-Markets
John Ronald Johnson Cornell University	The Effects on Sales of Special Cooking Quality Potatoes Separated by Specific Gravity—Consumer Acceptance in Retail Stores
Vernon Castle Johnson University of Wisconsin	A Survey of Leasing Practices and Problems in Wisconsin Agriculture
Masuda Khan University of Minnesota	An Evaluation of Minnesota Farm Price Index Numbers and Recommendations for the Future

Name and Institution	*Title*
Gordon Abbott King Harvard University	An Economic Appraisal of Alternatives to Dairying on Northern New England Farms
Lee Roy Kolmer Iowa State College	Spray Drying Costs in Low-Volume Milk Plants
J. O. Lammi University of California	Primary Money Income from Range Watersheds
Benoit Lavigne University of Wisconsin	Resource Productivity in Wisconsin Farming
Charles Edgar Lee University of Minnesota	Economic Effects of Sanitary Regulations Relating to Milk Markets
Don Lee Long Cornell University	Some Economics of Quality
Lewis Daniel Malphrus Purdue University	Farm Prices and Practices in Marketing South Carolina Hogs
Travis W. Manning University of Minnesota	An Analysis of the Economic Efficiency of Minnesota Dairy Cooperatives
Fred Richard Marti University of Florida	Retirement Farming in Hillsborough County, Florida
Wendall Marlin McMillan Pennsylvania State University	Financial Analysis of Farmer Purchasing Cooperatives in Pennsylvania
John Williams Mellor Cornell University	The Economics of Mechanization in Agriculture: A Study of Resource Substitution
Arthur H. Miller University of Wisconsin	Bulk Assembling of Wisconsin Milk Farm to Plant
Jarvis Ernest Miller Purdue University	Analysis of Factors Influencing Returns from Cattle Feeding, 1925-1951
Glen Hugh Mitchell Ohio State University	A Marketing Innovation, Prepackaging of Fresh Fruits and Vegetables with Special Reference to the Ohio Apple Industry

Name and Institution	*Title*
George Montgomery University of Minnesota	Wartime Control of Grain Prices in the United States
Richard R. Newberg University of Minnesota	An Analysis of Changes in Hog-Cattle Price Relationships, 1900-1953
Wyn Owen University of Wisconsin	Increasing Agricultural Production in a Relatively Well Developed Economy
Levi Mayland Parker Cornell University	The Potentialities of Irrigation From the New York State Barge (Erie) Canal in Northwestern New York
Arthur Pynnonen University of Wisconsin	Low Income in Agriculture: A Resource Use and Adjustment Problem
Sydney Chandler Reagan Harvard University	Peanut Price Support Programs, 1933-1952, and Their Effect on Farm Income
Harold M. Riley Michigan State College	Some Measurements of Consumer Demand for Meats
Niels Rorholm University of Minnesota	Linear Programming as a Possible Refinement of Farm Budgeting Techniques
Gordon Akin Rowe Purdue University	Improving Labor Productivity in Bottling Fluid Milk
Irwin Walter Rust University of Maryland	Trends in Motor Vehicle Accident Rates and Motor Vehicle Insurance Costs in Maryland, 1943 to 1953, With Particular Reference to Similarities and Differences Between the Accident Experiences of Farmers and Non-Farmers
Job Kitchen Savage, Jr. University of Wisconsin	The Effect of Nonmember Patron Business on Farmer Cooperatives
Clarence Peter Schumaier University of Illinois	An Analysis and Evaluation of the Grain Marketing System in Southern Illinois
Willard Donald Schutz University of Wisconsin	Evaluation of Federal Investment for Research Development

Name and Institution	*Title*
Edgar Trego Shaudys Ohio State University	A Critical Analysis of Ohio Dairy Production Cost Studies, With Special Emphasis on the Farm Approach
Seymour Smidt University of Chicago	Efficient Management for Government Wheat Stocks
Raymond Claris Smith University of Illinois	Factors Affecting Consumer Purchases of Frying Chickens
John Herbert Snyder University of California	Factors Affecting the Ground Water Economy of the Antelope Valley, Los Angeles County, California
Milton Harry Spencer Cornell University	Economics of the American Sugar Industry: Market Behavior and Government Policy
Koppa Venkataramaniah SriRam Purdue University	The Possible Effects of Freer Trade on the U. S. Soybean Producer
Bernard F. Stanton University of Minnesota	Using Farm Records in Decision Making in Livestock Production
Harold Ralph Stucky University of Minnesota	Settlement and Repayment Policies on Irrigation Projects
Ronald Leon Stucky Purdue University	Management Problems of Indiana Hatcheries
Daniel Webster Sturt University of Wisconsin	The Marketing of Cull Dairy Cattle in Wisconsin
Hasan Sheikh Ali Thamer University of California	Agricultural Policy in Iraq; a Study of Prevailing Conditions and Problems with Emphasis of Land, Credit, and Cooperation Reforms
Donald Woods Thomas Pennsylvania State University	An Economic Analysis of Deer Damage to Farm Crops, and Income from Deer Hunters, Potter and Monroe Counties, Pennsylvania, 1951

Name and Institution	*Title*
John Warren Thomas Iowa State College	Timing of Conservation Returns
George Thompson, Jr. Cornell University	Wholesale Flower Prices, 1940-50
Layton S. Thompson Michigan State College	An Analysis of the Decision Making Process of the Farm Firm as Related to the Construction of on the Farm Grain Storage Facilities
Thomas Edward Tramel Iowa State College	Distributions of the Fertilizer Production Function in Relation to Decision-Making
Edward Hazelberg Ward University of Wisconsin	The Influence of Technological and Legal Changes and the Likely Influence of Concentrated Milk on the Operation of the Montana Milk Control Law
Robert E. Weintraub University of Chicago	Earning Rates of Workers from Agricultural Areas and Labor Recruiting Elsewhere in a Southern Industrial Plant
Roger Harold Wilkowske Pennsylvania State University	Cost-Output Relationships Among Small Milk Businesses in Pennsylvania as Determined by Budgetary Analysis
Moyle S. Williams Purdue University	An Analysis of Rental Arrangements on Farms Producing Hogs
Egon Peter Winter University of Wisconsin	The Effects of the Relocation of a Cross-Country Highway on Land Values, Land Transfers and Land Uses
V. A. Wood University of Minnesota	Public Land Policy for Alberta
Roger Charles Woodworth Iowa State College	Economic Analysis of Protein-Grain Substitution Relationships in Pork Production
Norman Zellner University of California	An Economic Analysis of the California Prune Industry

NEWS NOTES

Annual Meeting, AFEA, Michigan State College, East Lansing, Michigan, August 1-3, 1955. Annual Meeting WFEA, Montana State College, Bozeman, Montana, July 18-20, 1955. International Conference of Agricultural Economists, Helsinki, Finland, August 19-28, 1955.

Helen Abell, who is on a 10-month leave of absence from the Economics Division, Canada Department of Agriculture, is serving as director of the Home Economics Training Course conducted by FAO in Jamaica. The course Miss Abell is directing has 50 students from the British West Indies in attendance.

Ralph G. Altman, Analytical Statistician with the U. S. Department of Commerce, has joined the staff of the Farm Income Branch, Agricultural Marketing Service.

W. J. Anderson of the Department of Agricultural Economics, The University of British Columbia, is acting as Economic Consultant to the Royal Commission investigating the marketing of fluid milk in British Columbia.

J. B. Andrews, University of Illinois, is on six-months sabbatical leave to study techniques of professional farm managers in the Midwest.

Henry H. Bakken has served on a state committee re-codifying the Wisconsin cooperative law. The proposed new law was presented to the Wisconsin legislature.

Roy S. Beck, transferred on February 14 to the Market Orders Branch, Dairy Division, Agricultural Marketing Service. Dr. Beck previously was with the Division of Agricultural Economics Programs, Federal Extension Service.

Eleanore M. Birch, previously employed as course assistant at Harvard Business School, has been appointed as Assistant Specialist in the Experiment Station at the University of California. Mrs. Birch will be working on research in Agricultural Economics at Berkeley.

Guy Black resigned from the Department of Agricultural Economics, University of California, to accept a position in electronics with Sylvania Corporation at Menlo Park, California.

John D. Black returned from Pakistan in February where he participated in the project of Harvard University to assist the Pakistan government in its work in economic planning.

R. Eugene Blair, Agricultural Statistician for cotton and fruit crops, in the California Crop Reporting Service at Sacramento, retired in June 1954, having completed more than 40 years in government service.

Karl Brandt, Associate Director of the Food Research Institute, Stanford University, returned in mid-March from Germany, where he served during the winter semester as Stanford exchange professor in the Department of Economics of the Free University of Berlin. Dr. Brandt's course was entitled "Agricultural Policy in the Modern Industrial State." He also lectured on phases of the general topic elsewhere in Germany and, during the Christmas recess, made a trip to the Belgian Congo.

Robert E. Branson has accepted an appointment as Associate Professor in the Department of Agricultural Economics and Sociology at Texas A. and M. where he will be engaged primarily in marketing research. Mr. Branson formerly was with the Agricultural Marketing Service of the U. S. Department of Agriculture, Washington, D. C.

Albert Brodell, Production Economics Research Branch, ARS, is back at his desk, following a major operation.

Gordon G. Butler was appointed in October 1954 as Agricultural Statistician in the fruit crop estimating work of the Agricultural Marketing Service in Washington, D. C. Mr. Butler had previously served as a State Assistant to William I. Bair, Statistician in Charge of the Federal-State office in Albany, N. Y.

Kendall Carpenter, who has been a Cooperative Agent of the Market Organization and Costs Branch, Agricultural Marketing Service, serving at Ithaca, has accepted an assistant professorship at Cornell University. He will be in charge of research and teaching relative to farmers' cooperatives.

H. C. M. Case visited Mexico and Costa Rica in February as part of a Latin American tour that will take him to the principal countries in this area. Professor Case's mission is connected with his position as Secretary-Treasurer of the International Conference of Agricultural Economists. As a result of his visit to these countries a fuller representation of the Latin American Agricultural Economists will be present at the forthcoming Helsinki conference and impetus will be given to formal organization of the Latin American groups.

Emily Clark, former Budget Officer of the Bureau of Agricultural Economics, has retired from the U. S. Department of Agriculture after 37 years spent in government service. All except a few months of Miss Clark's service was in the Department of Agriculture.

Robert L. Clodius, who worked with the Moffett Foundation of Harvard University during the fall semester, returned to the University of Wisconsin on February 1 to resume his teaching and research program.

Hubert L. Collins, Head Statistician of the Kansas Federal-State crop reporting office in Topeka, was detailed to the U. S. Census Bureau in October for about 9 months to assist in the 1955 Census of Agriculture. He has charge of the Census field headquarters at Pittsburg, Kansas. Jasper E. Pallesen is Acting in Charge at Topeka until his return.

Robert D. Davidson, Production Economics Research Branch, ARS, died of a heart attack on November 12. He had served the Department for more than 18 years.

Robert Lee Davis, Jr. returned to Mississippi State College, after a leave of absence to do graduate work at the University of Kentucky.

Carroll Downey, Analytical Statistician with the Statistical and Historical Research Branch, Agricultural Marketing Service, has transferred to the Farm Income Branch of the Agricultural Marketing Service.

J. C. Eiland, formerly with the Agricultural Marketing Service, has joined the staff of the Farmer Cooperative Service, U. S. Department of Agriculture. He will work with the Grain Branch of that agency.

Eldon Erickson, a graduate of the University of Nebraska, was appointed Extension Economist in Farm Management, Policy and Outlook, effective February 1, 1955, with the Nebraska Agricultural Extension Service.

J. K. Galbraith will be on leave of absence during the academic year 1955-56. During the summer of 1955 Professor Galbraith will be teaching in a special summer school for Indian scholars and research workers in Poona, India. The school is under the direction of Professor Austin Robinson of Cambridge University.

Sidney N. Gubin of the Price Division of the Commodity Stabilization Service, USDA, is now in Geneva, Switzerland on the United States team that is negotiating mutual tariff concessions with Japan and other countries as a basis for accession of Japan to the General Agreement on Tariffs and Trade.

Creighton N. Guellow was assigned in September 1954 as Statistician in Charge of the crop reporting office at College Park, Maryland, which is operated in cooperation with the University of Maryland. He succeeded Julius H. Peters who left the service to engage in private pursuits. Mr. Guellow has been serving in the Washington office of the Crop Reporting Board, Agricultural Estimates Division, Agricultural Marketing Service.

I. F. Hall, who served for 25 years as Extension Farm Management Economist in Wisconsin, retired December 31, 1954. Ike, as he was known to a large number of people, has not settled down to a sedentary life but is still active in managing a very large farm in the state.

John W. Hicks, Associate Professor of Agricultural Economics at Purdue, has become Assistant to the President of the University. He will continue in the Agricultural Economics Department on a part-time basis.

Clifford Hildreth has been appointed Professor of Agricultural Economics at Michigan State College, effective during the summer.

R. J. Hildreth has joined the staff of Texas A. & M. College as Assistant Professor of Agricultural Economics. He will do teaching and research in farm management. He received his doctoral degree in December from Iowa State College.

Paul L. Holm has transferred from the Lincoln, Nebraska, office of the Agricultural Marketing Service to the Washington office of the Production Economics Research Branch, ARS.

Henry Homme has joined the staff at North Carolina State College to work in the field of milk marketing research and teaching. Mr. Homme was formerly with Iowa State College.

J. P. Hudson has resigned from the Winnipeg Office of the Economics Division, Canada Department of Agriculture, to accept a position with the Field Service Section of the Manitoba Pool Elevators System.

Arthur D. Jeffery, Pennsylvania State University, has accepted the position of Regional Coordinator for the Northeast Regional Dairy Technical Committee. He will be located at Pennsylvania State University until July 1, 1955, at which time his headquarters will be moved to Cornell.

Paul J. Jehlik, Social Science Analyst with the Farm Population and Rural Life Branch, Agricultural Marketing Service, stationed at Ames, Iowa, transferred in February to the Federal Extension Service with official headquarters at Washington, D.C. His work will continue to be primarily in the field of rural sociology.

William O. Jones and S. Daniel Neumark represented the Food Research Institute of Stanford University at a meeting of representatives of Special African Programs in American universities, held at Evanston, Illinois, March 11-12, under the auspices of the Program of African Studies of Northwestern University. The African program of the Food Research Institute, inaugurated in September 1954 under a grant of funds from the Carnegie Corporation, concentrates on research in problems of food supply and economic development in Tropical Africa.

George M. Kuznets was granted extension of his special leave from the University of California to continue his study of Soviet agriculture, with particular emphasis on measurement of rates of growth, for the National Bureau of Economic Research. The leave as extended was from August 1, 1954 to April 30, 1955.

Thomas J. Lanahan, Jr., Analytical Statistician with the U. S. Department

of Labor, has joined the staff of the Statistical and Historical Research Branch, Agricultural Marketing Service, to do research in the consumption of agricultural products.

Clayton Libeau joined the staff at North Carolina State College, December 1, 1954, to do extension w rk in poultry marketing. Dr. Libeau formerly was at the University of Nebraska.

Clifton Loomis, formerly at the University of Missouri, joined the Department of Agricultural Economics at Cornell, February 1, 1955. He will work in the field of farm management extension, concentrating in the area of farm and home planning.

C. W. MacLean, on leave of absence from the Economic Division, Canada Department of Agriculture, is serving on a two-year assignment with FAO in Rome.

Donald A. McCandliss, who has been the State Agricultural Statistician in Charge of the Gulfport, Mississippi office since June 1922, except for several years' service in the Washington, D. C. headquarters of the Crop Reporting Board, retired on December 31, 1954 after more than 37 years of Government service. Ray B. Converse of the Raleigh, North Carolina office was selected to succeed him and took charge of the office newly located in Jackson. This office is operated in cooperation with the Mississippi Department of Agriculture and Commerce.

George K. McCutcheon has joined the staff of the Tractor and Implement Division of the Ford Motor Company. This Division is undertaking intensive research to determine the type of farm equipment that the American farmer will need five and ten years from now. Mr. McCutcheon plans to contact the various agricultural colleges and USDA experiment stations at least once a year in connection with this project.

J. M. Mehl, Administrator of the Commodity Exchange Authority in the U. S. Department of Agriculture since 1940, retired recently, and was succeeded by Rodger R. Kauffman, formerly Deputy Administrator. Mr. Mehl received the Distinguished Service Award of the Department in 1953 "for vision and leadership in developing Federal regulation of futures trading in agricultural commodities, and for fostering principles of equity and integrity in the Nation's commodity futures markets."

George L. Mehren is on special leave, January to June, from the University of California, to serve as technical consultant with Swift & Company on research into long-run market potentials, distributive channels, and supply sources.

Kenneth W. Meinken, formerly Analytical Statistician with the Farm Income Branch of the Agricultural Marketing Service, is now Assistant Professor of Agricultural Economics at Rutgers University.

Paul Miller, formerly Extension Sociologist and Associate Director of Extension at Michigan State College, has been designated as Extension Director, at Michigan State College.

Clarence A. Moore joined the staff at Texas A. & M. College August 1, 1954 as Assistant Professor in the field of farm management. He is a native of Texas and recently completed two years of graduate study at the University of Chicago.

Elmer J. Moore, formerly with the Reclamation Service at Fresno and Santa Barbara, California, has joined the Washington staff of the Market Organization and Costs Branch, Agricultural Marketing Service.

Willard F. Mueller joined the staff of Agricultural Economics at the University

of California at Davis on September 1, 1954. He was formerly a Research Associate at Vanderbilt University.

James A. Munger, who received his M.A. degree from South Dakota State College in January 1955, has been appointed Agent (Agricultural Economist) with the Western Field Research Section, PERB, and is stationed at the University of Nebraska doing research on farm bankruptcy and debt problems.

L. J. Norton has been named Head of the Department of Agricultural Economics at the University of Illinois. He succeeded H. C. M. Case who is serving half-time with the University and half-time as Secretary of the International Conference of Agricultural Economists.

K. H. Parsons spent four months in 1954 in the Near and Far East, arranging for a Land Tenure Conference. He returned to the University of Wisconsin in December.

Robert Partridge, Rural Electrification Administration, formerly assistant to Everett Weitzell, assumed Mr. Weitzell's former position of Program Analyst in the Administrative Division in September 1954. Prior to being Mr. Weitzell's assistant, Mr. Partridge was Head of the Economics Staff of the Applications and Loans Division, Rural Electrification Administration.

W. M. Pritchett has been promoted from Senior Agricultural Economist to a junior officer position of Executive Assistant at the Federal Reserve Bank of Dallas.

Stanley J. Provost has transferred to the Bureau of the Census from the Production Economics Research Branch, ARS.

L. A. Reuss, Production Economics Research Branch, ARS, has recovered from his automobile accident sufficiently to be on duty in his Florida office much of the time.

Joseph E. Rickenbacker, after completing class work for a Ph.D. degree at the University of Oregon, has been engaged as Agricultural Economist in the Transportation Branch of the Farmer Cooperative Service, U. S. Department of Agriculture. He will work on the problem of loss and damage to livestock in transit.

R. Wayne Robinson has been appointed Assistant Professor of Agricultural Economics in Extension at Kansas State College to prepare marketing and outlook materials for publication and distribution by the Extension Service. Mr. Robinson has recently completed graduate study at the U. of Wisconsin.

Floyd E. Rolf, of the state agricultural statistician's staff in Topeka, Kansas, transfered in August 1954 to the agricultural price statistics work in the Washington office of the Agricultural Estimates Division, Agricultural Marketing Service.

Richard Schmitt, Rural Electrification Administration, formerly Head of the Economics Staff of Applications and Loans Division, became Head of the Loan Review Section, Telephone Operations and Loans Division, REA, in August 1954.

Raymond C. Scott became Assistant Director, Division of Agricultral Economics Programs, Federal Extension Service, in December 1954. From mid-1952 to 1954 Dr. Scott was Chief of the Fruit and Vegetable Marketing Branch of the Division. Dr. Russell L. Childress is now Acting Chief of the Branch.

Harold R. Shaw, formerly an economist in the Department of Agriculture at Ottawa, Canada, has accepted appointment as Assistant Professor of Agricultural Economics with the University of California at Davis, California. His appointment to the staff on February 1, 1955 was another step toward com-

pleting the necessary teaching and research staff of that branch in the statewide Department of Agricultural Economics.

F. M. Simpson, agricultural economist at Clemson Agricultural College, has been honored by the Saddle and Sirloin Club of Chicago. His portrait will be hung in the club gallery along with oil portraits of other outstanding men of the livestock and meat industry. This honor is being given Professor Simpson for the part he played as director of the Agricultural Research Department of Swift & Company and the work he has done to bring about a better understanding between livestock producers and those who serve them in the marketing of their livestock and meats. During the time Professor Simpson worked in the industry, he developed a new type of newspaper and farm journal advertising, which has since been widely copied by other concerns. He has devoted more than 45 years to the marketing of livestock and meats. He retired from Swift & Company in April 1952 and came to Clemson as a member of the staff of the Department of Agricultural Economics.

Mildred B. Smith, of the University of Connecticut, is studying at the London School of Economics while on a six-months sabbatical leave. Miss Smith will return in July to resume her duties as Consumer Education Specialist with the Connecticut Extension Service.

Roy J. Smith, University of California at Los Angeles, is on sabbatical leave. He will make a survey of citrus handling, shipping, and marketing practices in selected areas of Western Europe, Israel, and eastern United States.

Stephen C. Smith left the employ of T.V.A. on February 28 to join the staff of Agricultural Economics as an Associate Specialist on ground water studies with the University of California at Berkeley.

L. Orlo Sorenson who has been doing graduate study at the University of Minnesota has been appointed Assistant Professor of Agricultural Economics at Kansas State College. He reported for duty January 1 to assist with research in grain marketing.

Leland Spencer, Professor of Milk Marketing at Cornell, gave expert testimony on principles of milk pricing in a court proceeding in California during the month of January. He also appeared as an expert witness at Vancouver in connection with a public inquiry concerning the milk control law of the Province of British Columbia.

Clyde E. Stewart, Production Economics Research Branch, who has been stationed at Bozeman, Montana for the past 5 years, recently transferred to Logan, Utah.

R. J. Sumner has been appointed to the position of Sales Manager of the Dried Yeasts and Derivatives Department of Anheuser-Busch, Inc., succeeding the late Mr. James D. Veron.

Glen A. Swanson transferred in August 1954 from the Washington office of the Agricultural Estimates Division, Agricultural Marketing Service, to become first assistant to C. J. Borum, State Statistician in Charge of the Michigan Federal-State crop reporting office at East Lansing.

James G. Sykes has returned to the University of Vermont as Assistant Agricultural Economist after spending three years with a large milk marketing concern in the Republic of Panama.

F. Uhlir has resigned his position with the Economics Division, Canada Department of Agriculture, to accept a position with King's College, Halifax, Nova Scotia.

D.B. (Woody) Varner has been designated Vice-President coordinating off-

campus activities at Michigan State College and Dean of Continuing Education. He will give attention to coordinating agricultural extension through the Dean of Agriculture, Continuing Education, and the off-campus extension activities of the School of Education.

Edwin C. Voorhies, University of California at Davis, is spending six months sabbatical leave in Europe to study the agriculture of Spain and Portugal, Western Europe, and the Scandinavian countries.

D.M. Warren, formerly with the Saskatoon office of the Economics Division, Canada Department of Agriculture, has accepted a position with the Income Tax Division, Department of National Revenue, Canada.

Everett Weitzell, Rural Electrification Administration, moved from Program Analyst to Chief, Telephone Operations and Loans Division in May 1954.

Chester M. Wells, Jr., Assistant Professor at Mississippi State College, is on leave for the spring semester while continuing his graduate study at the University of Illinois.

Richard Wheeler is now an Associate Professor in a research-extension position at Michigan State College.

Bennett White, Jr., who for several years was Head of the Division of Marketing and Transportation Research in the Bureau of Agricultural Economics, was appointed research coordinator for social sciences, including marketing, in the State Experiment Stations Division of the Agricultural Research Service in September of last year.

G. B. Whitman, University of Illinois, is on six-months sabbatical leave studying farm accounting projects in land-grant colleges.

Howard S. Whitney joined the staff of Texas A. & M. College on September 1, 1954, as Assistant Professor of Agricultural Economics. His primary assignment is research in grain marketing. He holds B.S. and M.S. degrees in Agricultural Economics from Oklahoma A. & M. College. Since 1947, with the exception of 1952-53 when he did graduate work in economics at The University of Chicago, he has been teaching and doing research in the field of grain marketing at Oklahoma A. & M. College.

James P. Wickham was appointed Instructor in Agricultural Economics at Montana State College on January 1, 1955.

Ramon Wilson, formerly of the California Department of Agriculture, has joined the staff of the Agricultural Economics Department at Purdue University as Extension Marketing Specialist.

Harry Wilt joined the Extension Service at Michigan State College as County Agent, effective March 1.

Harvey S. Woods, Production Economics Research Branch, ARS, has been appointed Cooperative Agent until June 30 to assist on an economic analysis of feeder calf production in southern Illinois. This is a cooperative project between the Illinois Experiment Station and Southern Illinois University.

James Young, formerly Retail Marketing Specialist at Purdue, has resigned his position to enter commercial work.

M. I. Zawadski, who received his Ph.D. in agricultural economics at the University of Illinois in 1954, is now at the University of Chicago doing research concerning Central European agriculture.

New Assistant Secretaries of the United States Department of Agriculture, recently confirmed and sworn in, are Ervin L. Peterson, Assistant Secretary for Federal-States Relations, and James A. McConnell, former CSS Administrator,

Assistant Secretary for Agricultural Stabilization. Earl Hughes of Illinois has been appointed CSS Administrator to succeed Mr. McConnell.

The Production Economics Research Advisory Committe held its 1954 meeting in Washington December 6-8. The Committee's formal report and recommendations to the Administrator of the Agricultural Research Service is in process. According to a press release, the Committee urged, among other things, a much greater expansion of economic research concerned with production adjustments on farms faced with reduced market outlets, stating that such studies are needed in all of the type-of-farming areas where wheat, cotton, and butterfat are major products. The Committee also recommended research to furnish an objective basis for guiding the development of cost-sharing and other public assistance programs for conservation and to show just how far these programs can and should go in bringing about desirable land use adjustments.

An Agricultural Economics course is being held in Lima, Peru from April 4 to June 30, for more than 20 participants from Venezuela, Colombia, Peru, Ecuador and Bolivia. The course is under the direction of Quentin West and is sponsored by Project 39 of the Technical Cooperation Program of the Organization of American States, administered by the Inter-American Institute of Agricultural Sciences. The course will cover aspects of Farm Management, Agricultural Statistics, Land Economics and Marketing. It will also include one month of practice in the field on aspects covered in the subject matter courses. The Agricultural School at La Molina, the National Extension Service (SCIPA) and FAO will cooperate with the Institute in this venture.

The University of Nebraska has been awarded a grant of $113,500 by *Resources for the Future, Inc.*, to conduct a study of adjustments needed in the use of resources in the transition farming area between the Great Plains and the Corn Belt. Philip A. Henderson and Howard W. Ottoson will be in charge of the project. The grant covers a three-year period starting July 1, 1955. Cooperating in the research work will be sociologists at the University of Nebraska.

Work on research and teaching in the field of conservation conducted at Harvard in recent years will be continued for the next three years under a special grant from *Resources for the Future*. This work is under the principal guidance of Dr. Ayers Brinser, Professor John D. Black, and Professors John Gaus and Arthur Maass of the Department of Government.

The University of Florida, North Carolina State College, Virginia Polytechnic Institute and the Southern Regional Education Board are jointly sponsoring a series of cooperative summer sessions in statistics. The first of these cooperative graduate summer sessions was held during the summer of 1954 at Virginia Polytechnic Institute. The second session will be held at the University of Florida from June 20 to July 29, 1955. A session is scheduled to be held at North Carolina State College in 1956, and another at Virginia Polytechnic Institute in 1957. Inquires should be addressed to: Professor Herbert A. Meyer, Statistical Laboratory, University of Florida, Gainesville, Florida.

PRELIMINARY PROGRAM

American Farm Economic Association
Annual Meeting

Michigan State College, East Lansing, Michigan, August 1-3, 1955

(The following includes only those who have agreed to prepare papers as of April 1955. Chairmen and discussants have not been indicated.)

SUNDAY, JULY 31

1:00-2:00 P.M. Registration

7:00-9:00 P.M. Informal Reception, Everyone Invited

MONDAY, AUGUST 1

8:00 A.M. Registration

10:00 A.M. *General Session*

Welcome–D. B. Varner, Michigan State College

ECONOMIC GROWTH AND DEVELOPMENT

1. Conditions and Rates of Economic Growth
2. Contributions of Agricultural Policies to General Economic Growth–Frederick V. Waugh, Agricultural Marketing Service, U.S.D.A.

1:30 P.M. *Group Sessions*

GROUP I–ECONOMIC IMPLICATIONS OF FARM AND HOME PLANNING WORK

1. The Role of the Agricultural Economist in a Farm and Home Development Program from an Administrator's Viewpoint–E. J. Nesius, University of Kentucky
2. Organizing Economic Research Specifically for Use in a Farm and Home Development Program–Sydney D. Staniforth, University of Wisconsin

GROUP II–THE ECONOMICS OF THE CONTROL AND USE OF WATER

1. The Development and Present Status of Water Rights and Water Policy in the United States–Wells A. Hutchins, Agricultural Research Service, U.S.D.A.
2. The Economic Issues in Water Development–S. V. Ciriacy-Wantrup, University of California
3. Organization and Administrative Arrangements for an Effective Water Policy–Harry A. Steele, Agricultural Research Service, U.S.D.A.

GROUP III–WELFARE IMPLICATIONS IN MARKETING RESEARCH AND EXTENSION

1. Welfare Implications of Market Differentiation and Control–George L. Mehren, University of California
2. Welfare Implications of Efficiency and Technological Improvement–Lawrence W. Witt, Michigan State College

GROUP IV–AGRICULTURAL FINANCING

1. Reorientation of Policies in Agricultural Financing
2. Measuring Risk in Farm Mortgage Lending–George K. Brinegar, University of Connecticut
3. Influence of Trade Financing on Broiler Production

GROUP V–DEMAND ANALYSIS

1. How Much Progress Has Been Made in the Study of the Demand of Farm Products?–Elmer J. Working, State College of Washington
2. A Comparison of Single and Simultaneous Techniques–Richard J. Foote, Agricultural Marketing Service, U.S.D.A.

GROUP VI–DAIRY PRODUCTION AND MARKETING PROBLEMS

1. The Impact of Technological Changes on Milk Production–R. G. Wheeler, Michigan State College
2. The Dairy Problem and Some Alternative Solutions
3. Economic Problems Associated with Milk Marketing Orders–E. W. Gaumnitz, National Cheese Institute

GROUP VII–IMPROVING THE USE OF AGRICULTURAL DATA

8:00 P.M. *General Session*

Awards Program–H. B. James, North Carolina State College

AGRICULTURE AND FOREIGN TRADE

The Current and Prospective Competitive Situation of the United States in World Markets–Karl Brandt, Stanford University

TUESDAY, AUGUST 2

9:00 A.M. *General Session*

ADJUSTMENT PROBLEMS IN A GROWING ECONOMY

1. Adjustments in a Growing Economy in Respect to Production–Earl O. Heady, Iowa State College
2. The Economic Basis for Price Supports in a Full Employment Economy–D. Gale Johnson, University of Chicago
3. Policy Issues of the Low-Income Farm Problem–Karl Fox, Council of Economic Advisers

1:30 P.M. *Group Sessions*

GROUP I–PROGRESS AND PROBLEMS IN DECISION MAKING STUDIES (With Reference to the North Central Farm Management Research Committee's Interstate Managerial Study)

1. The Nature of the Study–Harald Jensen, University of Kentucky
2. Possible Implications of the Study for Farm Management Research and Teaching–Lowell S. Hardin, Purdue University
3. Possible Implications of the Study for Farm and Home Development–Earl O. Heady, Iowa State College
4. Sociological Aspects of the Study–Woods Thomas, Purdue University
5. Methodologies Employed in Handling Subjective Data–Joel Smith, Michigan State College
6. The Universes of Farms Studied–C. B. Haver
7. The Friedman-Savage Utility Hypothesis in the Study–Glenn L. Johnson, Michigan State College

GROUP II–ECONOMIC-LEGAL APPROACH TO AGRICULTURAL PROBLEMS

1. Agricultural Land Laws as Obstacles and Facilitators in Attainment of Economic Objectives in Agriculture–John F. Timmons, Iowa State College

2. Guiding Principles as to How Land Laws Can Be Made to Serve Economic Ends—Jacob H. Beuscher, University of Wisconsin

GROUP III—SUPPLY ANALYSIS

1. Conceptualizing the Supply Function in Agriculture—Willard W. Cochrane, University of Minnesota
2. What Does the Supply Function Look Like?
   For Wheat
   For Dairy

GROUP IV—INDUSTRY COOPERATION IN MARKETING RESEARCH (Joint Session with American Marketing Association)

1. Assistance Available from Industry
2. Illustrative Studies
   Frozen Food Distribution
   Fruit and Vegetable Packing House Efficiency
   Merchandising Studies
3. Potential Opportunities

GROUP V—ACTIVITY ANALYSIS

1. Linear Programming as a Tool in Farm Management Analysis
2. Activity Analysis: An Agricultural Marketing Tool—C. E. French, Purdue University
3. Integrating Crop and Livestock Activities in Farm Management Activity Analysis—Earl R. Swanson, University of Illinois

GROUP VI—EVALUATION OF EXTENSION METHODS EMPLOYED IN FARM AND HOME DEVELOPMENT (Panel)

1. In the Midwest—N. S. Hadley, Purdue University
2. In the East—P. L. Putnam, University of Connecticut
3. In the South—M. S. Williams, North Carolina State College
4. In the West—Arthur Peterson, State College of Washington
5. Reappraisal—J. M. Nielson, Michigan State College

3:00 P.M. Student Section

4:00 P.M. Meet the Author Tea

5:00-7:00 P.M. Outside Dinner

7:30 P.M. *General Session*

AGRICULTURAL SURPLUSES—A PERMANENT OR PASSING PHENOMENON?

Problems of Stabilizing Farm Commodity Prices at Levels Above the World Markets

WEDNESDAY, AUGUST 3

8:30 A.M. Annual Business Meeting

10:00 A.M. *Group Sessions*

GROUP I—INTEGRATION OF RESEARCH AND EXTENSION IN AGRICULTURAL POLICY

1. Increasing Farmers' Understanding of Public Problems and Policies—J. Carroll Bottum, Purdue University

2. Methodological Problems in Agricultural Policy Research—George E. Brandow, Pennsylvania State University

GROUP II—RELATIVE EFFICIENCIES OF ALTERNATIVE TENURE SYSTEMS

1. A Framework for Analyzing Agricultural Efficiency—Walter E. Chryst, Agricultural Research Service, U.S.D.A.
2. The Application of Efficiency Concepts to Land Tenure Arrangements—Howard W. Ottoson, University of Nebraska
3. Two Empirical Techniques Applicable to Land Tenure Arrangements: Linear Programming vs. Single Equation Models—W. D. Toussaint, North Carolina State College

GROUP III—OBJECTIVES OF MARKETING EDUCATION PROGRAMS (Joint Session with American Marketing Association)

1. The Place of Consumer Education in Expanding the Demand for Food—Robert Kramer, Michigan State College
2. The Place of Merchandising and Promotion in Expanding the Demand for Food—R. D. Kohls, Purdue University
3. Predicting Market Acceptance

GROUP IV—THE LOW-INCOME FARM PROBLEM (Joint Session with the Rural Sociological Society)

1. Economic Aspects of the Low-Income Farm Problem—Kenneth L. Bachman, Agricultural Research Service, U.S.D.A.
2. Characteristics of the Low-Income Farmer—Louis J. Ducoff, Agricultural Marketing Service, U.S.D.A.
3. Sociological Aspects of the Low-Income Farm Problem—Olaf F. Larson, Cornell University
4. Part-Time Farming and the Low-Income Farm Problem—C. E. Bishop, North Carolina State College

GROUP V—THE ECONOMICS OF FORAGE PRODUCTION AND UTILIZATION

1. Economics of Evaluating Forage Production—Lowell S. Hardin, Purdue University
2. Problems Encountered in Studying the Economics of Forage Production and Utilization—Russell O. Olson, Ohio State University
3. Economic Application of Forage Production and Utilization Research—Irving F. Fellows, University of Connecticut

GROUP VI—WHAT IS THE FOOD INDUSTRY DOING TO STIMULATE THE DEMAND FOR FOOD?

1. Economic Aspects of the Food Advertising and Promotion Program—Herrell DeGraff, Cornell University
2. Programs for Stimulating the Demand for Food

1:30 P.M. *General Session*

POLITICAL ECONOMY RECONSIDERED

1. Scientific and Value Propositions in Policy Formation and Appraisal
2. Applicability of the Theories of Welfare Economics to Farm Policy Formation and Appraisal
3. The Role of the Agricultural Economist in Policy Formation

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